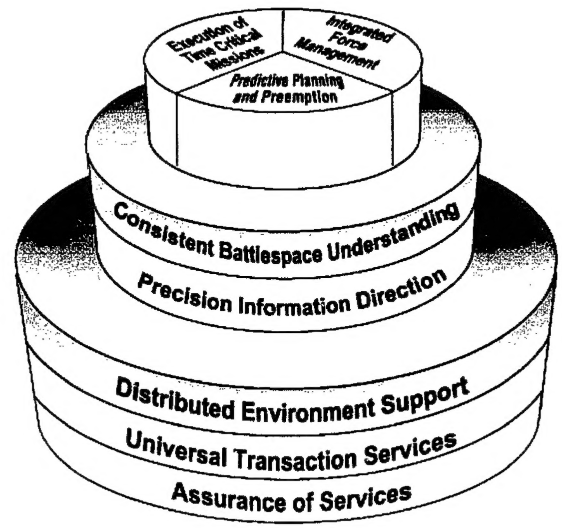

Advanced Battlespace Information System (ABIS)

Task Force Report

Volume II

Major Results

Director of Command, Control, Communications, and Computers (Joint Staff)

Director, Defense Research and Engineering (OSD)

May 1996

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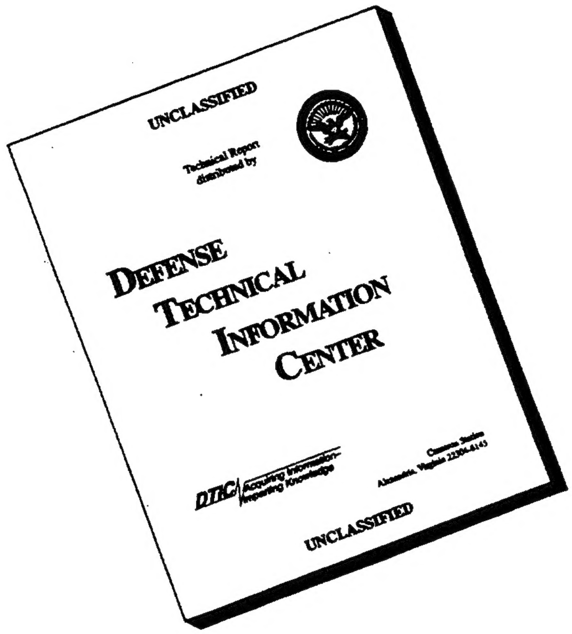

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Advanced Battlespace Information System (ABIS)

Task Force Report
Volume II

Major Results

May 1996

Preface

This is Volume II of the final report of the Advanced Battlespace Information System (ABIS) Task Force. The entire final report is organized into six separately bound volumes:

I. Executive Summary

II. Major Results

III. Battle Management Working Group Report

IV. Sensor-to-Shooter Working Group Report

V. Grid Capabilities Working Group Report

VI. Supporting Annexes

This volume contains the Major Results for the overall ABIS Task Force effort. This volume also integrates the results of the three working groups into an overall context, key products, conclusions, and recommendations.

Table of Contents

1. The ABIS Task Force

The ABIS Task Force

A Partnership Between the Director of Defense Research and Engineering (OSD) and the Director for Command, Control, Communications, and Computer Systems (Joint Staff).

Goals	• Ensure That the S&T Program for C4I Systems Is Aligned With Joint Vision 2010 • Develop a Strategic Framework for Key C4I System Architectural, Planning, and Programmatic Efforts
Objectives	• Identify Important New Operational Command and Control Capabilities and Enabling Technology Initiatives for an ABIS Construct • Identify Follow-on Actions Needed To Ensure the Timely Evolution of ABIS
Focus	• Future Major Regional and Lesser Regional Conflicts • Precision Application of Force in Time and Space • Advanced C4I System Concepts and Technology (2000-2010)
Format	• Executive Panel: DDR&E and Director, J-6, Joint Staff • DoD Review Group: Senior Representatives From More Than 30 Organizations • Study Leaders: Dr. D. Signori*, CAPT A. Heisig, Mr. E. Brady • Three Working Groups – Battle Management (Co-Chairs: Col R. Fly, Mr. D. Eddington) – Sensor-to-Shooter (Co-Chairs: CAPT S. Soules, Dr. B. Deal) – Grid Capabilities (Co-Chairs: Col S. Dalrymple, Dr. H. Frank) • Two Off-Site Meetings (September 95, February 96); and a Final Report in May 1996 *Executive Secretary of the ABIS Task Force, and Director of the Integration Team

The ABIS Task Force

The basic purpose of the ABIS Task Force was to better align the science and technology program with the emerging Joint Vision 2010. The Task Force sought to develop elements of a C4I strategic framework that could guide key planning, architecture, and programmatic efforts and ultimately impact doctrine and training development as well. The ABIS Task Force was established as an initial step in forming a partnership between the Director of Defense Research and Engineering (OSD) and the Director for Command, Control, Communications, and Computer Systems (Joint Staff).

Initially, the Task Force was asked to identify important operational capabilities and needed technology initiatives for an advanced battlespace information system. During the course of the effort, the task was expanded to include the identification of follow-on actions, needed to ensure the timely evolution and fielding of new operational capabilities.

The Task Force focused on precision force operations (dominant maneuver, precision strike and full dimension protection) in both Major Regional Conflicts and Lesser Regional Conflicts. Emphasis was placed on the C4I portion of the system-of-systems (i.e. new concepts and technology for sensors and weapons were not included) and advanced concepts and technology that could result in fieldable capabilities by 2000-2010. The Task Force did not seek to be comprehensive but rather to focus on defining a set of important capabilities derived from an understanding of the future operational context and to develop the audit trail to critical technologies and needed operational demonstrations. Funding was not considered.

Composed of three Working Groups (Battle Management, Sensor-to-Shooter, and Grid), the ABIS Task Force had DoD-wide representation and an extensive oversight, review and integration process. Emphasis was placed on ensuring strong representation from the operational community. Off-site meetings, at the beginning and end, were used to ensure even broader coordination and participation, by inviting added participants.

Scope of Effort

- Areas Included:
  - High-Level, Strategic Framework
  - Precision Force Combat Extending to the Year 2010
  - Capability-Based Force in a Variety of Situations
  - C2 Concepts and Enabling Technologies
  - Future Sensor and Weapon Capabilities Based on Current Development and Acquisition Programs
  - Maturity and Anticipated, Time-Phased Availability of Information Technologies From Government and Industry
  - Relevance of Current Technology Base and Demonstration Programs
  - Defensive Information Warfare
- Areas Excluded:
  - Assessments and Recommendations for Sensors and Weapons
  - Details of Architectures, Migration Path for Systems, and Changes to Specific Programs
  - Funding Requirements for Recommended Initiatives
  - Supporting Combat Functions, Such as Mobility, Logistics, and Medical
  - Noncombat Activities, Such as Peacekeeping and Humanitarian Operations
  - Weapons of Mass Destruction
  - Offensive Information Warfare

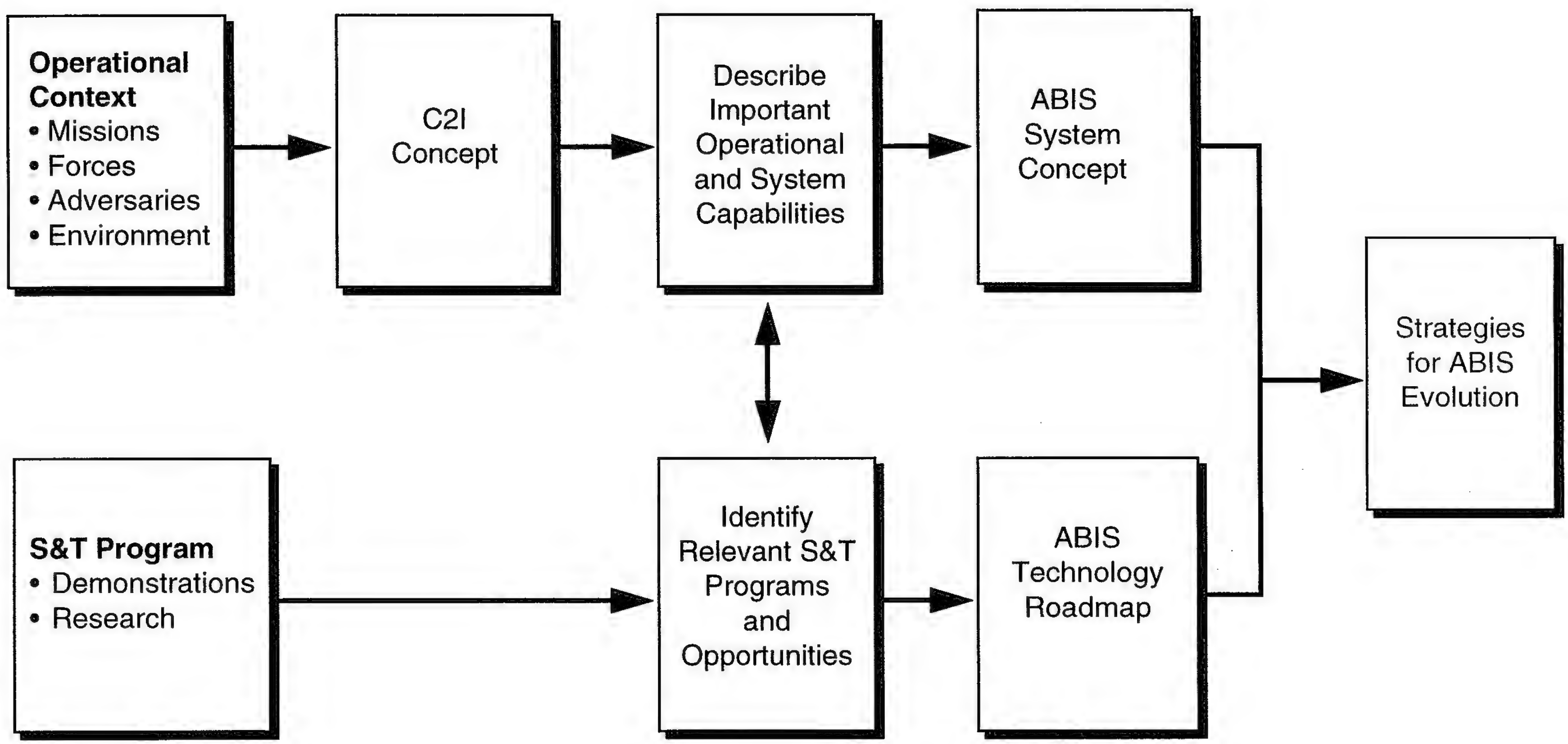
Scope of Effort

From the outset, the intention of the Executive Panel was to conduct a relatively short, intense, strategically focused effort. The scope of work was modified several times to better address the needs of the J-6 and DDR&E. This early Post-Cold War era is a formative period characterized by considerable "planning" throughout the Department of Defense. Thus, as the ABIS effort progressed, it was desirable and beneficial to increase the scope to provide timely inputs to ongoing J-6 and DDR&E planning activities, as well as to provide more enduring and encompassing results.

The main focus of this effort was to develop concepts for future C4ISR capabilities (not including the actual sensors) and for necessary science and technology efforts to enable these capabilities. A number of necessary implementation initiatives were discussed in sufficient detail to indicate the needs and proposed general nature of the initiatives, but there was no intent to develop specific system design, architecture, or implementation details.

The ABIS effort focuses mainly on future conventional warfare and combat activities to develop a general concept of key needed capabilities that can be extended later to cover a broader spectrum of military activities.

Task Force Methodology



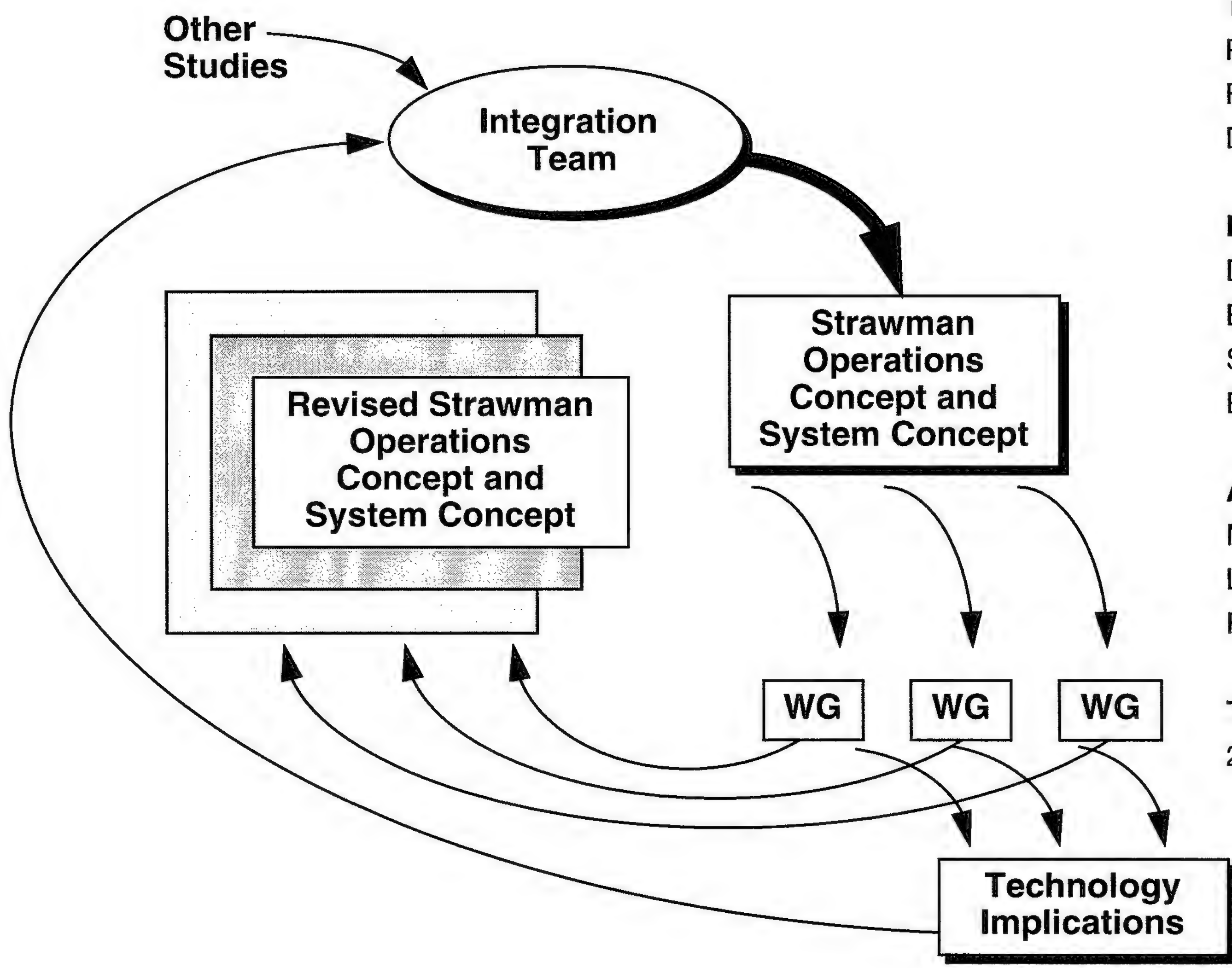
Task Force Methodology

The Task Force considered a likely future operational context that included a range of missions, forces, and adversaries within their respective operating environments, including weather, terrain, and geographic location. Within this operational context, the Task Force simultaneously and interactively considered needed future operational command and control capabilities, necessary enabling technology, and the likely availability of technology during the next 15 years. By relating operational force needs and future C4I system capabilities, and then deriving needed critical functions to overcome limitations in current capabilities, the Task Force was able to map the needed functions to key enabling technologies. (See pages 3-7, 3-8) This mapping created a clear logic and audit trail relating future command and control capabilities and enabling technologies.

The Task Force then considered when the identified technologies would likely be able to support operationally meaningful enhancements as steps toward desired capabilities. Task Force members relied on their existing familiarity with commercial technology trends because there was insufficient time for a current in-depth assessment of future commercial information technology. The Task Force also examined current DoD demonstration and technology programs to identify shortfalls. This examination provided a basis for recommending areas needing emphasis in the technology base along with a time-phased set of demonstrations.

In addition, the Task Force identified key initiatives and strategies for evolving and implementing the ABIS and associated operational concepts.

An Iterative Process



Type of Operation:
Precision Engagement
Full Dimensional Protection
Dominant Maneuver

Phase of Operation:
Deployment
Early Battle
Sustained Battle
Excursion for Crisis Response

Adversary:
Major Regional Contingencies
Lesser Regional Contingencies
Future "Peer Competitors"

Time Frames:
2000, 2010

An Iterative Process

The task force of approximately 130 government personnel was organized into an Integration Team and three Working Groups (Annex E of Volume VI contains a list of all members) to address the functions of Battle Management, Sensor-to-Shooter, and Grid Capabilities. Recognizing the overlap in these topics, it was thought that exploring the same operational contexts from different functional perspectives, and exploring the same technology for different applications might prove useful. The Task Force was fortunate to be able to start with material and recommendations from the J6 PSISR* Study; thus, the Working Groups' initial focus was on precision engagement, while initial input material was gathered on full-dimensional protection and dominant maneuver. To examine issues, potential concepts, and technologies from a variety of perspectives, the Task Force addressed a near-term and long-term time frame, multiple scenarios, and a variety of adversarial capabilities. Each Working Group proceeded somewhat differently; however, each considered the same overall context and made recommendations from the perspective of their subject area. The Integration Team developed the study methodology, prepared and provided input material for each phase of the Working Groups' efforts, prepared the mapping and assessment of current programs against future needs, consolidated results into an integrated assessment and perspective, and prepared the overall report. (Volume VI describes the methodology in more detail.)

Each Working Group functioned both separately and in close coordination with the others. Throughout the study, coordination meetings between the Working Group co-chairs and the Integration Team augmented the individual Working Group meetings and Integration Team meetings.

The Integration Team Leader met frequently with the Executive Panel, and the Working Group Co-Chairs periodically briefed the Executive Panel on their progress. The Working Group Co-Chairs and Integration Team Leader also provided reports to the DoD Review Group. In addition, there were two major off-sites: at the National Defense University in September 1995, and at the Army National Guard Readiness Center in February 1996. At each off-site, selected additional personnel from outside the task force and oversight groups attended to ensure broader participation and perspective.

* Precision Strike Intelligence, Surveillance, Reconnaissance

Overview of the ABIS Task Force Findings
(The Remainder of Volume II Is Structured In This Order)

New Force Employment Concepts	Information superiority will permit future commanders to shape the battlespace and control the pace and phasing of engagements by rapidly integrating widely dispersed force elements to mass effects at the right time and the right place
New Command and Control Concepts	New force employment concepts will require a flexible, agile, distributed command structure with varying modes of command, continuous proactive planning, and empowered execution
New System-of-Systems Concepts	Advanced technology will enable a system-of-system construct that provides user tailored information support separate from the command and control process with modular heterogeneous applications and a federated grid of flexible, assured services requiring a minimal forward footprint for operations throughout the world
Technology Initiatives	There is a need for sustained, concerted effort to focus technology research and operational demonstrations in critical areas to lay a solid foundation for ABIS
Implementation Initiatives	Timely and incremental fielding of ABIS capability requires that we change the process for development and assimilation of technology and operational concepts so as to remain militarily superior through the ongoing Revolution in Military Affairs

Overview of the ABIS Task Force Findings

The operational application of information technology will be key to U.S. military strategy as we enter the 21st century. Joint Vision 2010 recognizes this and emphasizes the broad use of advanced information technologies to significantly improve traditional military capabilities. Joint Vision 2010 also emphasizes protection of our information capabilities and the degradation of an adversary's ability to use his own command and control systems (i.e. information warfare). Understanding the implications of this vision and identifying needed capabilities and enabling programs is a challenging task.

The key product of the Task Force is a strategic capability framework for the Advanced Battlespace Information System. It identifies operational capabilities needed for 2010, maps them to critical command and control functions, and then to the technologies that enable performance of those needed functions. The framework also outlines a broad system construct that follows the principles of a federation. The federated system would provide warfighters with a robust, flexible, knowledge based environment of information and communication services. Achieving the ABIS requires the continual integration and use of rapidly advancing information technologies as a key element in maintaining global military superiority. The ABIS framework also provides a guide for sustained investment in a broad set of identified enabling information technologies coupled with a time-phased set of specific operational and technical demonstrations.

Achieving timely advances in combat power in the field requires a number of DoD functional organizations to interact in accordance with the long term ABIS vision and framework. The Task Force outlined a strategy for achieving this. The strategy emphasizes the interaction of users, concept developers, technologists, and system developers in a set of experiments and demonstrations within a network of advanced technology testbeds. This testbed environment is necessary to increase and accelerate the coordination between advances in force employment, and command and control concepts; doctrine and training; science and technology; and system acquisition and life-cycle support activities. Important new initiatives in DoD command and control planning, architecture, and testbeds are underway. These initiatives need to be integrated and extended to include a broader range of participants. In addition, much work remains to be done to strengthen these mechanisms and make them a part of the formal DoD organization and acquisition processes. This effort must explicitly improve the process for integrating system components based on new technology into evolving systems, and to evaluate the contribution to operational effectiveness attained by enhancing specific operational capability threads, as opposed to upgrading an entire system.

The partnership between the operational and technical communities started by the ABIS Task Force not only needs to continue but also must expand and be strengthened by including others in DoD necessary to implement this important part of Vision 2010. The remainder of Volume II elaborates on these findings in the sequence indicated in the accompanying figure.

2. An Evolving Operational, and Command and Control Context

The Future National Security Environment

An Era of Dynamic Changes, Constrained Resources, and Widely Varied and Uncertain Adversaries Demands Greater Flexibility and Discrimination

Potential Adversaries

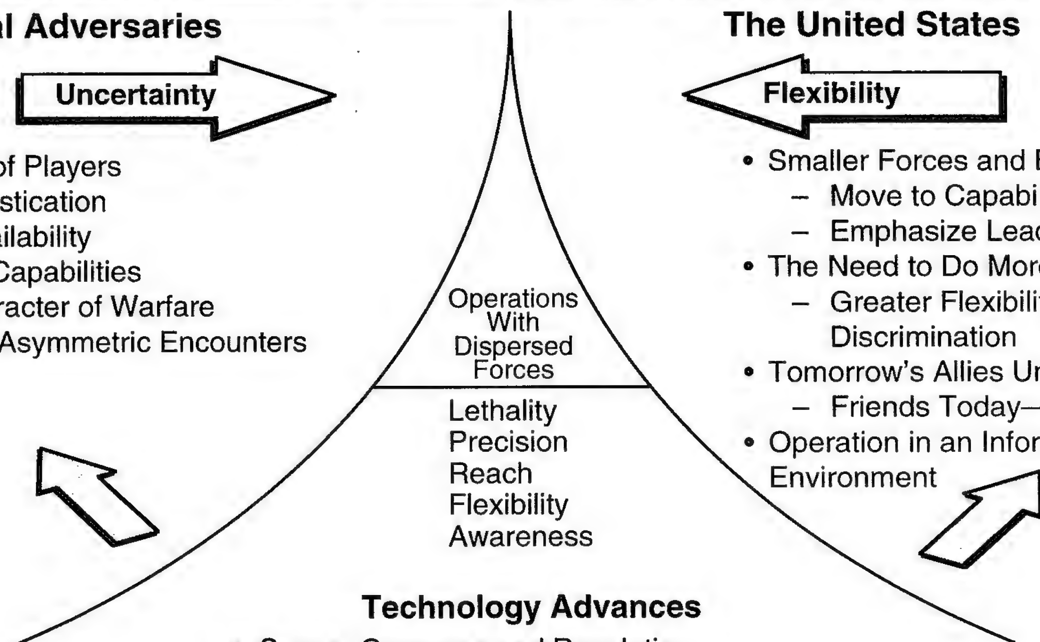
Uncertainty

- Wider Variety of Players
- Growing Sophistication
  - Market Availability
- More Diverse Capabilities
- Changing Character of Warfare
  - Deliberate Asymmetric Encounters

The United States

Flexibility

- Smaller Forces and Budgets
  - Move to Capability-Based Force Structure
  - Emphasize Leadership and Initiative
- The Need to Do More With Less
  - Greater Flexibility, Precision, and Discrimination
- Tomorrow's Allies Uncertain
  - Friends Today— Enemies Tomorrow
- Operation in an Information Warfare Environment



Technology Advances

- Sensor Coverage and Resolution
- Precision Guided Weapons
- Information Systems (Commercial and DoD)
- Broader Range of Desired Weapons Effects
- Stealth and Signature Reduction

Capitalizing Quickly on Emerging Technology To Develop New Operational Capabilities Is Key

The Future National Security Environment

U.S. forces will face major challenges in the future national security environment, which will be characterized by change and uncertainty. Our forces have to deal with a broader range of sophisticated adversaries—often more than one simultaneously in geographically separated locales. In addition, we will have to maintain security with a smaller force structure as dictated by current budget reductions. Maintaining military supremacy in this global context requires a capability-based force structure that can be utilized with flexibility, precision and discrimination, as well as an increased emphasis on leadership and initiative.

This challenge will be met in the context of an ongoing revolution in military affairs for which technological advances is one of the major drivers—leading to significant improvement in battlespace awareness, reach, precision and lethality and dictating greater dispersal of forces to ensure their survivability. These trends, combined with additional improvements in information systems, will form the foundation for information-based warfare. In addition, this can be the basis upon which the U.S. can be more effective with a smaller force.

Because much of this technology is proliferated throughout the world, many of our potential adversaries are increasing their level of sophistication and will participate, as well, in the revolution in military affairs. It is crucial that the United States be able to rapidly assimilate emerging technology and develop and implement new operational concepts so that we maintain our military advantage, including our current advantage to collect, process, disseminate and use battlespace information.

Operational Uncertainty and a Capability-Based Force

- To Maintain U.S. Military Superiority in the Early Part of the 21st Century, U.S. Military Forces Must Be Capable of the following:
  - — Credibly Deterring Major Conventional Warfare
  - — Militarily Prevailing, With Minimal Casualties, in Sustained Combat in a Wide Variety of Situations Against Diverse Adversarial Capabilities, Including a Major Regional Military Force
  - — Successfully Conducting a Wide Variety of Operations in Which the Use of Force May or May Not Occur
- A Resource-Constrained, Capability-Based Force Must Be Focused on the following:
  - — The Most Likely Set of Operational Needs
  - — Avoiding Catastrophic Vulnerabilities
  - — Guarding Against "Technology" Breakouts of Potential Adversaries
  - — Deliberate Use of Asymmetrical Advantages Against, and by, Potential Adversaries

Success Requires Global Awareness and Management of Risk

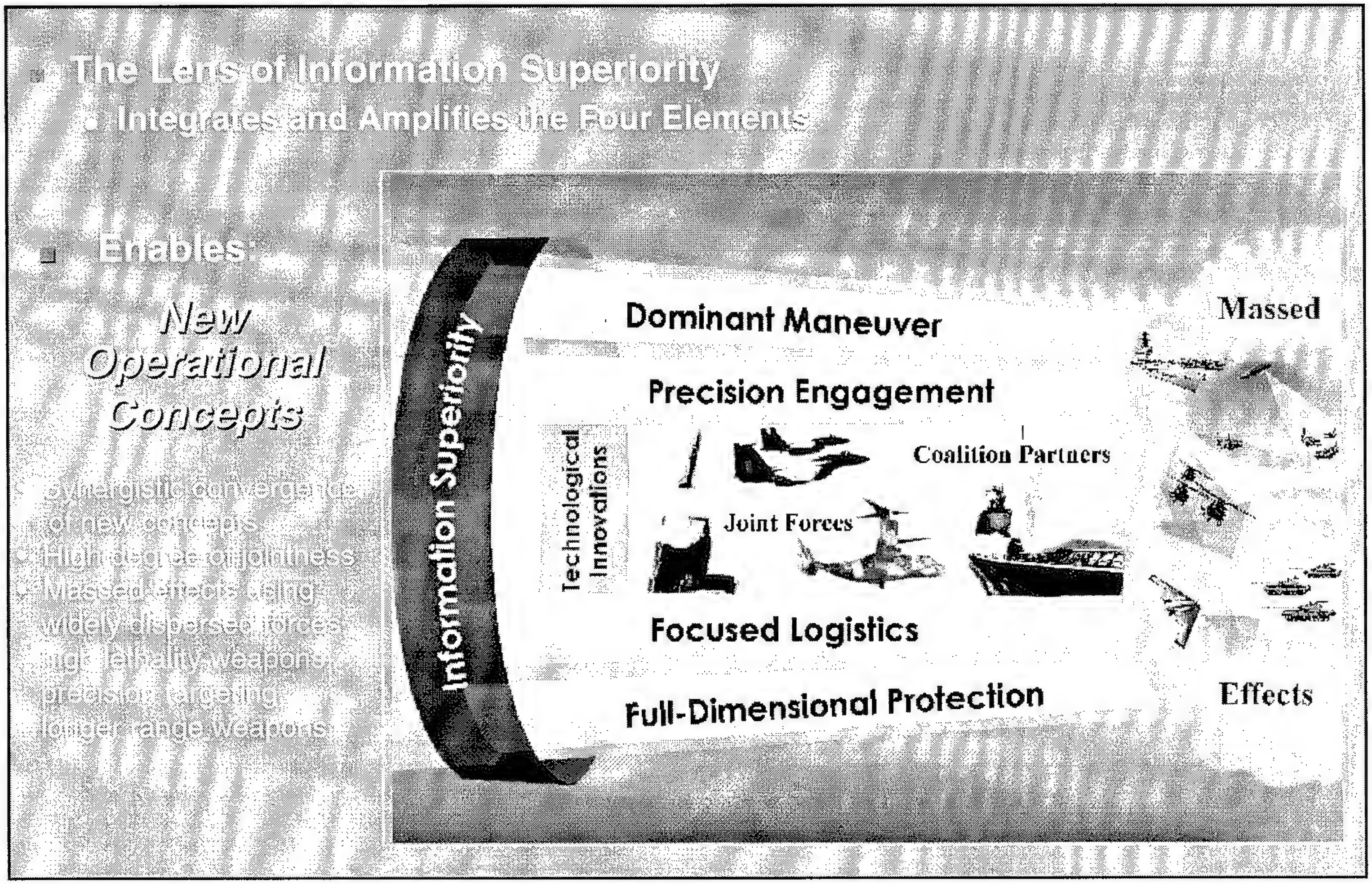
Operational Uncertainty and a Capability-Based Force

One of the key transitions the United States military is undergoing is a shift in its approach to force planning from a "requirements-based" force to a "capability-based" force. The new approach requires that choices be made regarding the overall capability of U.S. forces in the absence of an explicit enemy from whose capabilities the requirements for U.S. forces can be derived. It is not possible, and certainly not affordable, to design against all possibilities. Thus, some "envelope of performance" must be defined that balances several factors: the ability to achieve U.S. foreign policy and military objectives, a variety of potential operational contexts and adversaries, probability of occurrence and risk to U.S. forces, the rate of technological improvement, and cost.

The highest military priority is to be able to deter and, if necessary, prevail with minimal casualties during conventional combat. The ability to successfully accomplish other functions in other contexts must come second. This capability ranking was used in the ABIS study as a way to focus attention and to judge the importance of different military capabilities. Similarly, focus was on areas of maximum leverage to gain advantage and to address areas of greatest vulnerability. Although the ABIS construct is focused on cases that meet these criteria, emphasis also is placed on flexibility and robustness that supports broader applicability to all combat phases and to operations not directly involving combat. Some other cases involving the use of military forces need further investigation and experimentation to validate or adapt the ABIS results.

Finally, it is important to have a robust R&D program tied to the full envelope of capabilities anticipated for future environments. In this way surprises can be minimized and the availability of technology is less likely to be a major hurdle in responding. Such a strategy should be coupled with an active intelligence effort to determine if and when a capability should be acquired and fielded.

Key Elements of Joint Vision 2010



Information Superiority Enabled by Command and Control, Fused All Source Intelligence, Dominant Battlespace Awareness, and Offensive and Defensive Information Warfare.

Key Elements of Joint Vision 2010

Joint Vision 2010 focuses on achieving dominance across the range of military operations through the application of new operational concepts. Joint Vision 2010 describes how, enabled by information superiority, we will be increasingly able to realize the effects of mass with less need to mass forces physically than in the past. Concentrating combat power decisively and with precision at the proper time and place will achieve massed effects. Common across these new concepts is the need for control over information throughout the battlespace. Information superiority is a lens that both focuses and enhances the four key operational concepts of :

- Dominant Maneuver
- Precision engagement
- Full-dimensional protection
- Focused logistics

Dominant maneuver is the multidimensional application of dispersed information, engagement, and mobility capabilities in a sustained and synchronized way to control the battlespace and attack enemy centers of gravity to achieve a decisive advantage. Precision engagement ties together high fidelity target acquisition, prioritized requirements, and command and control of joint forces to engage the adversary, assess our level of effect, and retain the flexibility to reengage with precision when required. Full dimensional protection, using both active and passive measures, is based on control of the battlespace to ensure that our forces can maintain freedom of action during deployment, maneuver, and engagement while providing multilayered defenses for our forces and facilities at all levels. Focused logistics relies on the fusion of information, logistics, and transportation technologies to provide rapid crisis response, to track and shift assets even while enroute, and to directly deliver tailored logistics packages at all levels of operations. The synergy of these four concepts will enable the U.S. to dominate the full range of military operations.

In implementing these advanced operational concepts, emphasis will be placed upon empowered leadership and initiative, rapid global power projection, maintaining widely dispersed forces with a capability for rapidly achieving mass effects, and the widespread and enhanced use of information and information technologies.

The concept of Information Superiority is a key element for many other concepts. It emphasizes multidimensional awareness and assessment and an ability to execute friendly operations before an adversary can effectively respond. Concurrently, it stresses protection of our own information capabilities as well as the ability to degrade our adversary's use of his information capabilities. Being able to integrate advanced information technology into a systems context is a key element in providing an order of magnitude improvement in our ability to robustly plan, execute, and achieve full spectrum dominance.

Operational Concept for the Forces

- Achieve Overwhelming Effect in a Compressed Time by:
  - — Speed of Command
  - — Controlling the Shape and Pace of the Conflict and Its Battles
  - — Disrupting the Adversary's Processes and Cycle Times, and Exploiting Resulting Opportunities
  - — Denying an Adversary the Ability To Disrupt Our Processes and Cycle Times
- Conduct High Lethality Attacks on High Priority Targets and Centers of Gravity by Orchestrating:
  - — Responsive, Comprehensive Sensor Coverage
  - — Highly Mobile, Agile Dispersed Forces
  - — Standoff Precision Weapons
  - — C2 Systems and the Supporting Information Infrastructure
  - — Information Warfare Activities
- Deploy a Minimal Footprint and Logistics Tail in the Area of Operations
- Ensure Graceful Degradation to Some Minimum Essential Capability

Operational Concept for the Forces

Joint Vision 2010 and the implications of the future national security environment establish an operational concept for the forces. This operational concept constitutes the foundation on which the needed future command and control, and ABIS concepts are constructed. This future battlespace has two key features. The first is that as the United States and others continue to improve sensing and strike capabilities, forces will be increasingly dispersed to minimize causalities (i.e., the "empty battlespace"). Second, all entities that can will increasingly use information technology to seek advantage (e.g. speed of command).

The basic operational objective is to achieve overwhelming effect in a compressed time with minimal friendly causalities. Two broad means are envisioned to achieve that objective. First, the force will seek to control the shape and pace of battle. This control will be implemented by dominating an adversary with precise, concentrated fires from many platforms and by outmaneuvering an adversary's forces, engaging only when it is advantageous or unavoidable. Second, the force will seek to disrupt the adversary's cycle time by employing both lethal means (e.g., conducting disrupting attacks and preempting, if politically and militarily feasible) and nonlethal means (e.g., employing information warfare to disrupt/degrade an adversary's forces and national command authority).

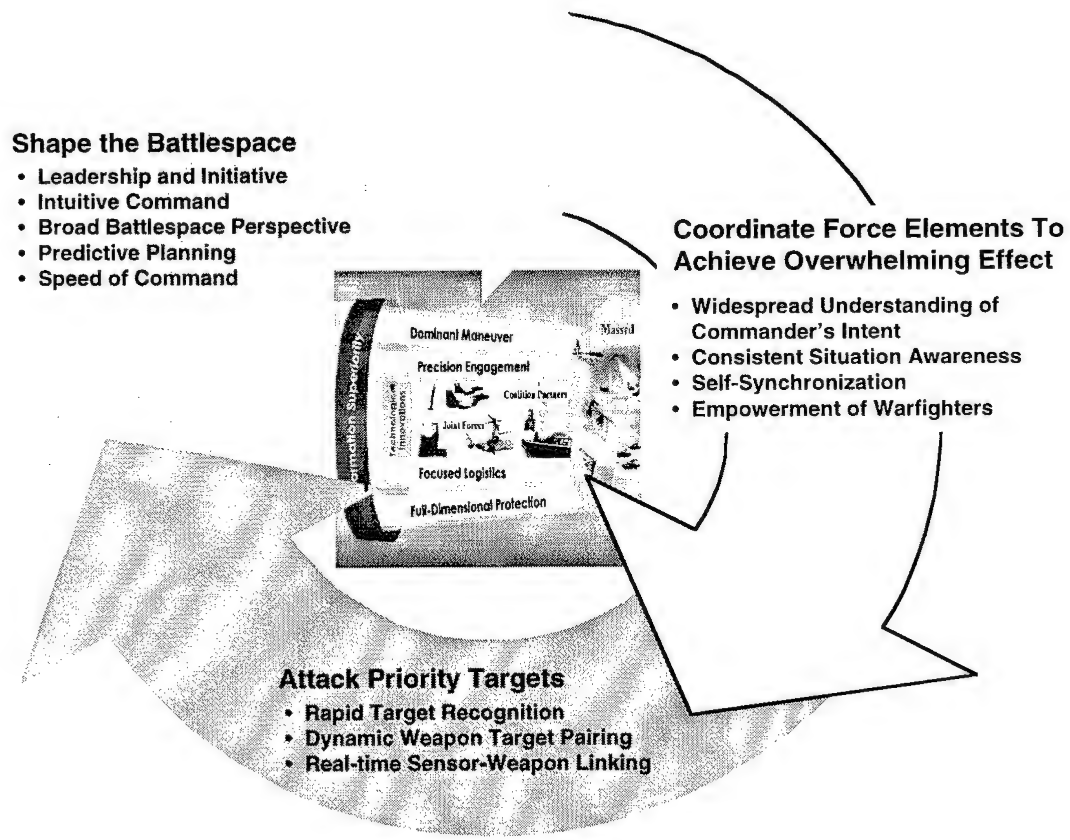
A key enabler of these two broad means involves highly lethal attacks against high priority targets and centers of gravity. To achieve this capability operationally, it is necessary to orchestrate across a complex set of activities and systems. One of the elements of that set is a comprehensive mix of sensors that can be managed responsively to provide coverage of the battlespace to support battlespace awareness, targeting, and battle damage assessment. A second element is having highly mobile, agile forces, that can outmaneuver an adversary's forces. A third element entails having standoff, precision weapons that can be responsively focused on time-critical targets. A fourth element requires C2 systems and a supporting information infrastructure to enable commanders and their staffs to employ their understanding of the battlespace to formulate and disseminate plans and orders to exert effective control over the battlespace and achieve force synchronization. It is this command and control segment of the total system that is the key to leveraging our substantial investments in sensors, forces, and weapons. Finally, an information warfare capability is required to degrade the effectiveness of the adversary's composite capability and to protect corresponding elements of our own system.

The proposed operational concept calls for the deployment of a minimal footprint and logistics tail in the area of operations, i.e. focused logistics. This concept is motivated by the realization that there are likely to be few forward-based U.S. forces in the theater, limited tactical warning of an initial attack, simultaneous operations elsewhere in the world that require the sharing of key resources, and a threat to in-theater forces by weapons of mass destruction. Providing multilayered defenses, both active and passive, for our forces and facilities at all levels will serve to further minimize causalities.

Finally, it is recognized that any capability will suffer degradation because of adversary actions and unintended consequences of friendly operations (e.g., mutual interference among systems). To prepare for this eventuality, it is necessary to identify and protect a minimum essential capability that can be counted on, despite the concerted efforts of the most effective adversary. This concept has its roots in our nuclear forces, where a minimum essential capability was identified and ensured through a mix of redundancy, hardening, and training.

New Force Employment Concepts Enabled by Information Superiority

Information Superiority Will Permit Commanders To Control and Shape the Pace and Phasing of Battle by Rapidly Integrating and Synchronizing Dispersed Forces to Mass Effects at the Right Place and Time.



New Force Employment Concepts Enabled by Information Superiority

Information superiority enables new operational concepts for force employment. These concepts include self synchronizing forces; accelerated speed of command; agile, adaptable organizations; empowered tactical decisions at the lowest levels; and focus on combined and massed effect as opposed to focus on management of seams between forces.

Information Superiority ensures that friendly forces have a superior awareness and understanding of the current and projected situation, as well as the commander's intent and can deny similar awareness and understanding to the enemy. It also implies that friendly forces can better accommodate uncertainty by applying both knowledge and judgment in an effective way.

Such a capability provides commanders at all levels a broad perspective of the battlespace allowing them to be proactive in applying force at the right time and at the right place to shape the battlespace, control the pace and intensity of engagements, and operate within the cycle time of the adversary. Shared perception, and common understanding of the situation and the commander's intent across dispersed force elements, facilitate synchronization and responsiveness to changing situations and coordination, or self synchronization, across the entire force to achieve overwhelming effect. The result is increased speed of command that will be of critical importance in determining combat outcome.

Leadership, empowerment and initiative of commanders and individual warfighters are facilitated by providing our forces the ability to quickly visualize changes in the battlespace. Such visualization can be enhanced by assisting warfighters in the use of both their experience and intuition to fill in gaps in collected information, and to understand the true implications of these changes by acquiring and using superior knowledge of the situation.

Finally, the robust ability to rapidly detect, recognize, and prioritize targets; assign forces and weapons; and support attack in real time translates into an ability to attack high value targets and centers of gravity while protecting our own forces throughout the battlespace.

Information Superiority, Speed of Command, and Operational Uncertainty

- A Force Based on an Ability To Achieve Information Superiority and Speed of Command Must Account for a Wide Range of Operational Capabilities
- Situations of Considerable Variation in
  - Type of Information Needed
  - Availability of Information
  - Quality of Information
  - Varying Composition and Mission of Deploying Force Structure, and Degree of Integrated Operations
- Operating in Challenging Environments Such as Urban Areas, Jungles, Mountains, Poor Weather, Isolated Locations, Etc.
- Operating Against Adversaries About Which Little May Be Known in Advance
- Operating With Allies of Uneven Capabilities Relative to Our Own
- Varying Ability of an Adversary To Deceive, Degrade, and Disrupt Our Information Activities

There Is a Need for Robust C2 Concepts and Adaptable System Capabilities That Permit Forces To Operate Within a Realistic Envelope of Performance

Information Superiority, Speed of Command, and Operational Uncertainty

Information superiority is a potentially powerful lever on operational effectiveness. However, that leveraging can introduce similarly powerful negative factors if operational uncertainties are not accommodated. Therefore, the C2 and system concepts must address some key issues. Foremost are issues associated with situations of widely varying information availability and quality, methods of organizing and fighting with a composite force of varying information capabilities, and means of ensuring maintenance of the desired information environment in naturally and deliberately stressful situations.

Consequently, command and control concepts and supporting systems must be robust, flexible, and reconfigurable to address the needs of a wide range of operational environments and force employment concepts. In addition, warfighters must be able to make the best use of available information and to cope with warfare's inevitable ambiguities and uncertainties. There also must be backup and recovery modes to allow warfighters to adapt to loss of information or services caused by combat.

New Command and Control Concepts

New Operational Concepts Require a Flexible, Agile, Distributed Command Structure; With a Capability for Continual Proactive Planning and Empowered Execution.

- Leadership Supported by a Dynamic Blend of Command Approaches: i.e., Positive Control, Delegation, by Negation and Supporting Procedures
- Self Adaptive Learning Organization That Has a Flattened Hierarchy With Agile, Augmented and Distributed Staff Structure
  - Cross-Functional, Organizational Elements Spawned for Mission/Task Duration
  - Direct "on-Line" Support to Executing Forces
- Continual Concurrent Planning and Execution
  - Each Element Operating on It's Own Cycle Accommodating Inherently Different Operating Rhythms
  - All Tasks Coordinated by Tying to Central Strategy
- Proactive, Dynamic Planning and Near-Realtime Replanning Based On
  - Projecting and Assessing Enemy and Friendly Likely Courses of Action
  - Monitoring and Assessing Degree of Mission Accomplishment
- Initiative Enabled by Empowered Execution, as Appropriate
  - Local Authority Over ISR and Strike Processes
  - Direct Local Access to Necessary Information Independent of Command Structure

New Command and Control Concepts

The new force employment concepts enabled by information superiority require changes in command and control organizations and processes. Existing command and control organizations are strongly segmented along lines that reflect both command hierarchy and the division of functional areas. In the future, it must be possible to rapidly adapt command and control capabilities to changing operational situations. The command and control system of the future must be able to accommodate a mixture of command approaches ranging from tight positive control by direction, to delegation and control by negation. Warfighters must be able to structure their command and control organizations and processes dynamically to suit specific deployments, changing situations, and personal leadership preferences, and to achieve the highest efficiency and effectiveness of command.

The future command and control organization must be an adaptive organization that can adjust its processes as learning takes place. Information must flow in an orderly way to the element that needs it. Information flow generally is independent of the command hierarchy. Indeed, if delivery of near real-time information is essential, then a more direct path is required. This "flattened" structure would permit on-line support to be provided directly to any element within the force. This approach will also accommodate distributed battle staffs and splitbase operations, and allow the forward "footprint" to be reduced, with more of the staff functions performed out of theater.

Future command and control processes must support proactive, dynamic planning and near real-time planning adjustments based on a timely and accurate understanding of the situation, the current degree of mission accomplishment, and the simulated outcome of alternative futures based on observations, known constraints, and prior experience. The organizing principle of this adaptative process is to support the central strategy in a coherent way. Capabilities of the ABIS will give commanders the flexibility to exercise centralized or decentralized command and control as deemed appropriate for the situation.

A key feature of the new command and control concept is continual, concurrent planning and execution. This differs from the current concept in which a full planning cycle precedes execution. The new concept provides continuous iteration between portions of planning and execution to reduce response time and to match the planning-execution cycles to operational drivers and constraints, not to predefined command and control process cycles. Planning and execution of specific missions and tasks are tied to a central strategy to provide overall coherence and unity of command.

The decentralized approach supported by an ABIS architecture enables distributed empowerment. Information superiority, as discussed previously, provides a basis for distributing decision making while maintaining coherence across the force. Commanders responsible for executing specific parts of the plan will have increased authority and information to make decisions and manage resources associated with their tasks. This will include increased delegation of authority over intelligence, surveillance and reconnaissance (ISR) assets and over maneuver, strike, and protection assets. Initiative to make decisions and to execute will be delegated in a way that allows forces to be self-synchronizing and used to maximum effectiveness. Information access and the tools of command must be appropriate to a unit's combat power independent of command echelon.

3. Future Operational C2 System Capabilities and Enabling Technologies

The ABIS Vision

ABIS Will Give Warfighters a Knowledge-Based System Environment That Facilitates Revolutionary Operational Capabilities

The Advanced Battlespace Information System (ABIS) Is an Evolving Federated System-of-Systems Construct That:

- Enables Warfighters Everywhere To Acquire and Use Knowledge
- Allows Employment of Forces, Weapons, and Sensors in a Revolutionary Manner
- Helps Sustain US Military Supremacy Across the Spectrum of Conflict in the 21st Century

Such Supremacy Requires Concurrent Advances in Command and Control and Force Employment Concepts Along With the Continual Assimilation and Utilization of Advanced Information Technology

The ABIS Vision

The ABIS Task Force produced a guiding vision to focus operational and research and development efforts toward a common end. The ABIS is the future global system-of-systems. It has a supporting information architecture shared by the many federated, heterogeneous systems and services that are elements of the ABIS. It allows warfighters, at all echelons, to: (1) rapidly acquire, manage, exchange, and understand the massive amount of information relevant to the situation; and, (2) respond and adapt, better than any adversary, to war's dynamics, uncertainties, and ambiguities.

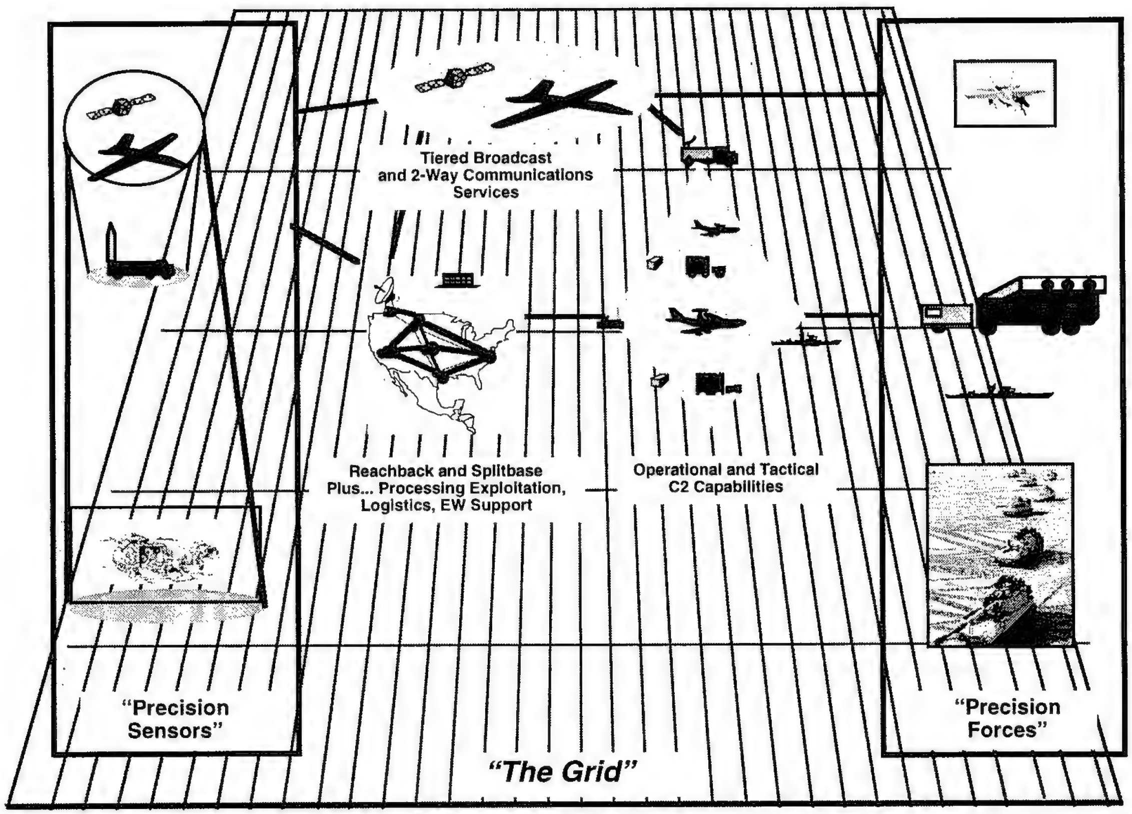
Throughout history, technological innovation has profoundly influenced military concepts and doctrine, offering significant advantage to the nation that recognized and leveraged the opportunities created by innovation. The current revolution in military affairs, which has accelerated since the end of the Cold War, is being driven by important changes—particularly the emergence of information technology as a commercial and social force. Knowledge-based systems are evolving at a rapid rate and affecting all forms of competition and all aspects of national security. To keep up with this rapid innovation and ensure that U.S. forces have technological capabilities that match or exceed those of the enemy, new products (both commercial and military), services, and technologies must be inserted to properly evolve from the current patchwork C4I systems.

The United States has an opportunity to capitalize on its expertise in developing and applying advanced information technologies by leading the global shift to a new type of information-based warfare that emphasizes delivery of comprehensive knowledge to warfighters at the tactical level. This differs from current practices that focus mainly on providing support at the strategic and national levels. The ABIS vision focuses on using information technology to provide warfighters the knowledge that will permit them to employ forces and mass effects in revolutionary new ways to ensure U.S. military supremacy into the 21st century.

The ABIS study methodology of mapping advanced technology to operational needs (see pages 3-7 and 3-8) seeks to provide an orderly progression from the stovepipe systems of today to meet the challenges of Joint Vision 2010. As systems continue to evolve, information technology becomes the enabler that allows interoperability, decentralization, restructuring, and adaptation to new situations, capabilities, and procedures. The challenge is to get the right information in a useable form into the hands of the warfighter in a manner that allows for faster and more accurate situational assessment and response than the enemy is capable of producing.

The Advanced Battlespace Information System

A Federation of Systems That Forms an Underlying Grid of Flexible, Shared, and Assured Information Services and Provides Advanced Capabilities in Support of New Command and Control and Force Employment Concepts.



General Principles
- User-Tailored Information Environment
- Emphasis on Knowledge and Understanding
- Access Separate from C2 Hierarchy

C2I Applications
- Tools and Knowledge Bases To Support Battlespace Awareness, Planning and Execution
- Plug and Play Into Heterogeneous, Distributed Environment

Information Grid
- Shared, Tailorable Services
- User Aids for Universal Access to Information
- Support for Dynamic, Distributed, Collaborative Processes
- Robust Global Connectivity and Interoperability with Support to Mobile Users

General Features
- Small Local Footprint With Reach-Back Capability
- Flexibility To Support Wide Range of Operations
- Ability to Minimize and Manage Degradation

The Advanced Battlespace Information System

The Advanced Battlespace Information System is not a new program to develop a worldwide information system. Rather, it is a set of underlying information services, technologies, and tools that enable us to achieve the broad operational warfighting capabilities described in Joint Vision 2010. Visualized as a collection of distributed data and applications, integrated through a grid of supporting services, ABIS acquires, processes, and delivers information, as needed, to enhance decision making at all echelons involved in operational functions such as real-time battle management, sensor-to-shooter correlation, and multidimensional battlespace awareness.

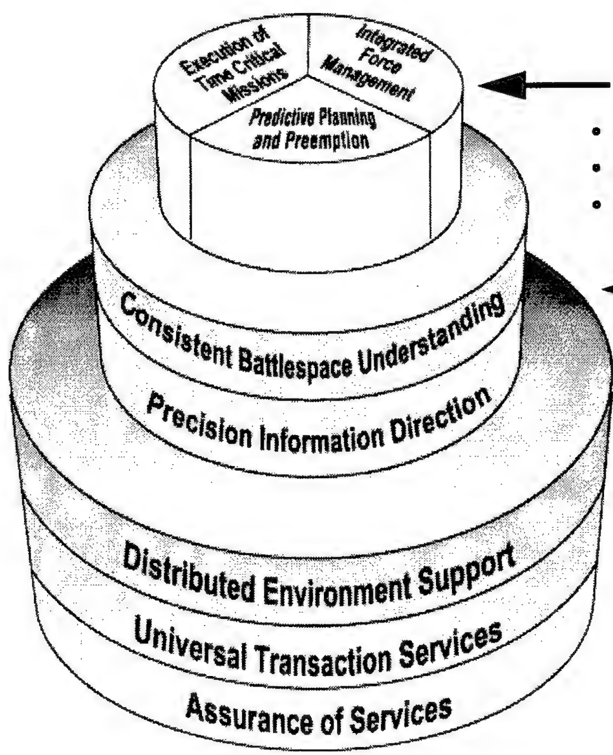
ABIS can be adapted to facilitiate changes in the configuration or procedures of the organizations that it serves. The plug-and-play nature of the federation of systems allows it to be configured and reconfigured as necessary. It will be possible to reconfigure, grow, and shrink the underlying communications for command and control, as well as the warfighting and mission-support systems with their processing and data storage requirements. This tailoring will be dynamic and rapid.

The foundation of the ABIS is a common-user information grid that ties sensors, shooters, command posts, and suport facilities together into a single integrated global environment. The grid enables systems and organizations out of theater, including those in CONUS, to be immediately responsive to and supportive of those in the theater. Key to integration is a common set of data elements, user-selected information display options, and redundant high speed communications.

The grid itself is an asset that must be managed to serve command objectives. The ABIS can defend and protect itself, and continue to operate in a managed and predictable way when under attack. The grid is a managed resource so that services, with their underlying communications and computer processing, are directed to be in support of mission priority operations.

ABIS Capability Framework

The ABIS Capability Framework Has Three Tiers: Upper Tiers Rely on Services Provided by Lower Tiers



Effective Force Employment
- Rehearse, Evaluate and Adapt Plans Rapidly
- Synchronize Distributed Force Operations
- Acquire Targets and Execute Timely Response

Battlespace Awareness
- Collaborative Situation Assessment
- Consistency of View Across All Forces
- Tailored Information Distribution

The Information Grid
- Single Federation of Heterogeneous Information Systems
- Infrastructure Support of Distributed Processes, Information Search, and Collaborative Work
- Seamless Responsive Communications
- Assured, Managed Resources Support Mission Priorities

ABIS Capability Framework

The Task Force identified a set of operational capabilities that ABIS must provide to meet the spectrum of challenges facing the United States in the 21st century. This set of capabilities forms a framework that can be portrayed as three supporting and supported layers: effective force employment, battlespace awareness, and a grid of common information services. Those layers on top of other layers depend on the lower layers for certain services and for inputs.

The foundation of the framework is an information grid, which provides infrastructure and services that establish a supporting information environment. Grid capabilities fall into three general areas: distributed environment support, universal transaction services, and assurance of services. They provide warfighters and their systems the ability to exchange information and work collaboratively, unimpeded by differences in connectivity, processing, or interface characteristics. The grid provides generic, robust services to support warfighters as they tailor their information environment to include local and remote organizations, people, and assets.

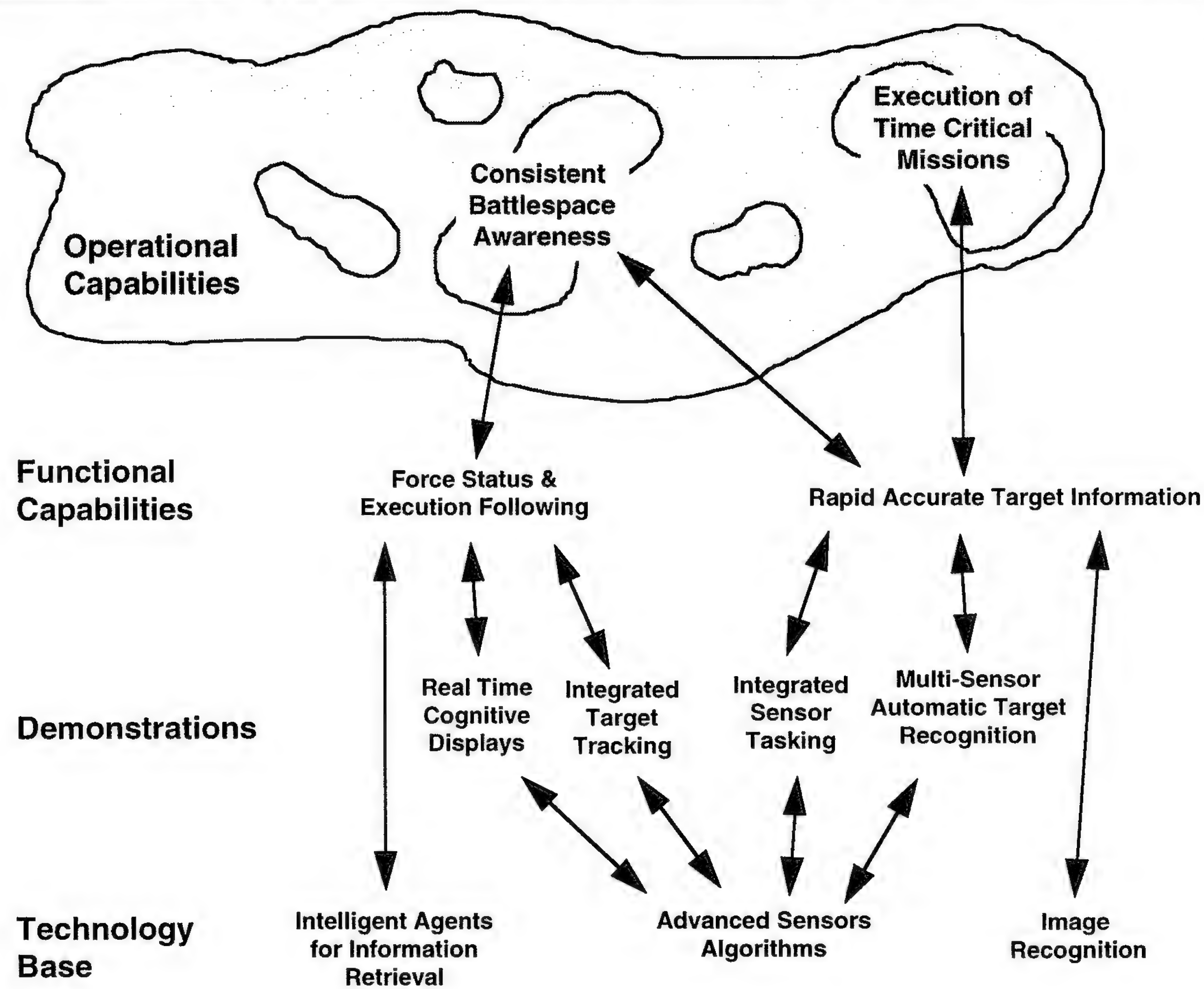
The second tier of the framework is a battlespace awareness capability, which is composed of precision information direction and consistent battlespace understanding. Precision information direction involves the ability to collect, process, and channel information to users in a timely and precise manner. It implies the ability of any warfighter to tailor his environment to support his mission needs by directing where different kinds of information can flow, when it flows, and in what form it appears. Information collection, processing, and dissemination must be dynamically focused on achieving the warfighter's specific mission objectives. Battlespace understanding involves consistent and collaborative assessment of an operational situation and objectives, including assessment of relevant support aspects. Assessors will typically be distributed across multiple locations and will not need the raw information, but will need information in the form conducive to the task at hand.

Effective force employment, the third level of capability, depends on the existence of battlespace awareness and grid capabilities and interacts with both. It has many interactive parts, three of which were developed by the ABIS Task Force: predictive planning and preemption, integrated force management, and execution of time-critical missions. Predictive planning and preemption allows our own forces to preempt rather than react, to rehearse and evaluate possible outcomes, and adapt plans rapidly even during execution. Integrated force management is supported through the shared use of knowledge. Linked staffs, warfighters, and automated processes manage dispersed forces and the synchronous execution of missions. Execution of time-critical missions is the capability to seize opportunities to acquire targets and to execute attack missions rapidly. This includes sensor tasking, weapons assignment, and dynamic replanning.

The Task Force had a deliberately narrow focus on force employment. A broader view—for example, to include logistics—might result in capabilities being added to facilitate any processes unique to other mission functions.

Mapping Operational Capabilities to Technology Developments

Key Needed Technologies and Demonstrations Have Been Identified for, and Related to, Critical Functions Associated With Important Operational Capabilities Required for the ABIS Construct.



Mapping Operational Capabilities to Technology Developments

The Task Force developed a methodology for explicitly mapping between operational capabilities and supporting technology developments. Beginning with future operations, the Task Force identified 32 critical functional capabilities needed to support desired operational capabilities of the next century. To map from operational to functional capabilities, the Task Force assessed future military missions, potential threats, and combat environments.

When these functional capabilities were determined, it was possible to derive specific technology demonstrations that will enable the warfighter to explore how new technology, and possibly new processes and procedures, support the performance of a given function. Those demonstrations depend on transitioning technology from one or more of the research and development efforts in the DoD and commercial industrial technology bases. Demonstrations then were mapped to supporting technology development efforts.

This mapping is symmetrical. It can be used to trace from emerging technologies to prospective new operational concepts and back again. The figure depicts an example of the final mapping. It should be noted that in some cases, multiple technology advances are needed to support a single demonstration. In other cases, the same technology can support multiple demonstrations. Still in other situations, technologies can enable new capabilities without the need for any demonstrations. The ABIS Task Force found that in most instances, the same functional capability supported multiple operational capabilities, and typically one operational capability depended on multiple functional capabilities.

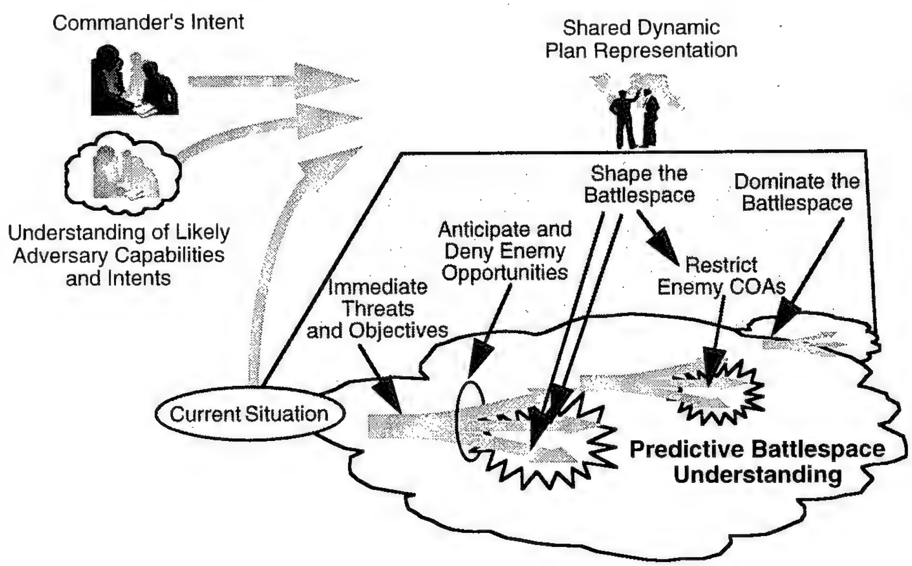
The set of assessed technologies explicitly includes commercial and government information technology advances insofar as known to the Task Force. The Task Force understood that the commercial market drives the rapid advancement of information products, such as processors, memory, displays, communications, architectures, and languages. However, much scientific discovery and long-term maturation of emerging technology on which these products are based are supported by the federal government, including DoD. And, there remains a significant need to develop technologies to meet unique military needs either in performance or timely availability; to understand and apply commercial technology to military problems; and to tailor and integrate commercial technology into military systems. To give one example: the commercial Internet began as the DoD ARPAnet. Though it is one model for the future military information grid, the Internet lacks crucial attributes such as security and resource allocation based on (mission) priority.

Fielding advanced military capabilities as interoperable systems, before they are generally available in the global commercial marketplace, is a crucial element in maintaining military superiority. It is particularly important to demonstrate technology in a military application so that the operator can evaluate utility and consider doctrine changes. The methodology permits the warfighter and technologist to mutually deliberate the relation between technology potential and operational options for the future.

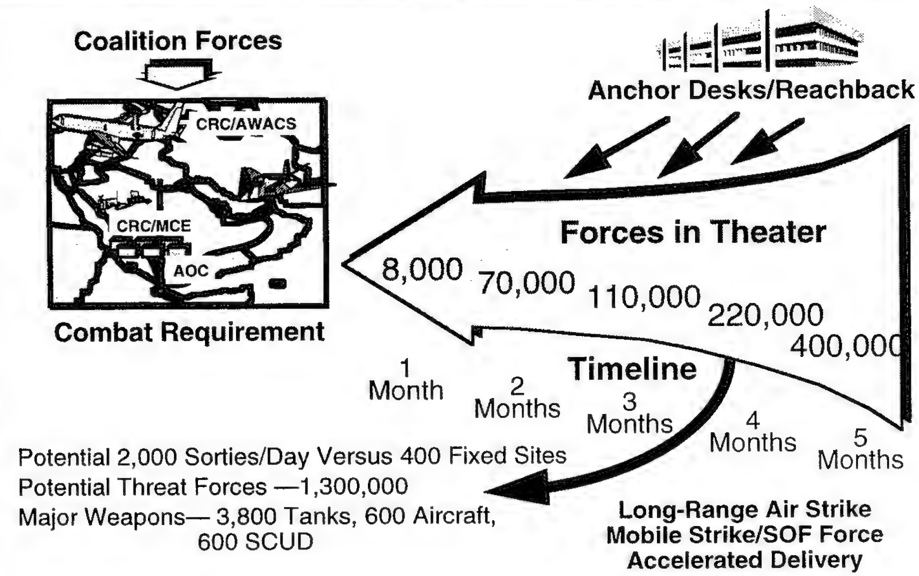
In the remainder of this section of Volume II, the critical functional capabilities and needed technologies are identified for each of the operational capabilities in the capability framework.

Predictive Planning and Preemption

Goal: Lean Forward in the Planning Process, Exploit Opportunities, and Shape Expected Actions To Stay Within the Enemy's Decision Cycle. Be Able To Fight From Any State Using Tailored Early Force Packages, Virtual Deployment, and Global Reach.



Predictive, Continuous Planning



Incremental Force Projection

Critical Functional Capabilities

- Shared, Dynamic, Distributed, and Continuous Collaborative Planning
- Situation Projection
- Dynamic Tasking Tied to Central Strategy Throughout the Joint Force
- Command Projection
- IW and Spectrum Dominance Monitoring, Planning, and Execution
- Automated Mission-to-Target and Weapon-to-Target Pairing
- Repair and Consumables Management
- Force Status and Execution Following

Predictive Planning and Preemption

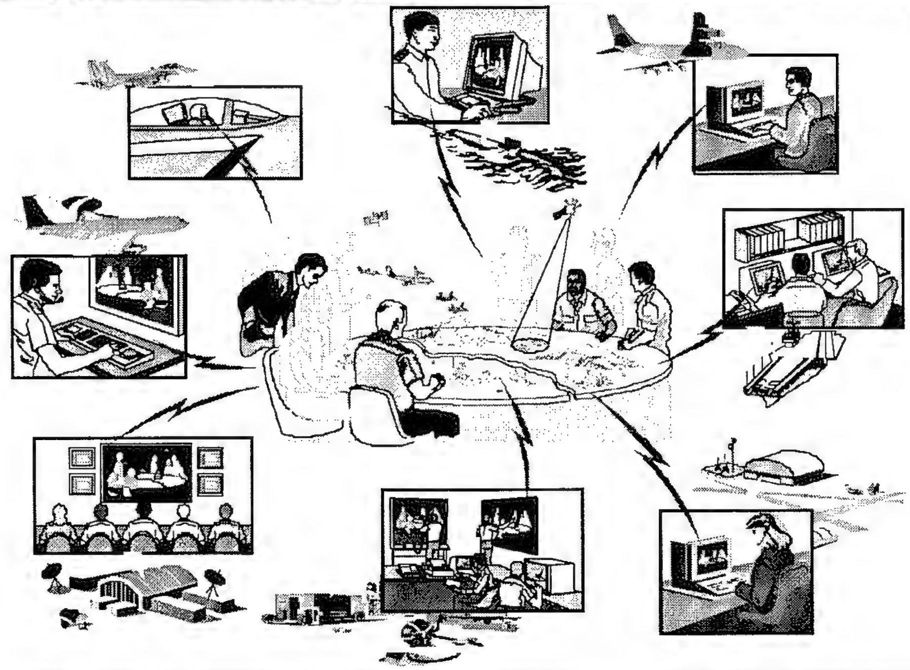
Predictive Planning and Preemption includes all functions involved in the planning for missions, by echelons and components in carrying out warfare from hours to days ahead. The principal elements for this operational capability are the following:

- A predictive, look-ahead capability to assess current battle outcomes, to anticipate enemy actions, shape the battle, exploit opportunities, and dominate the decision cycle
- A fully integrated information warfare and spectrum dominance battle management capability for a total warfare planning process
- An incremental force projection capability supported by incremental command projection involving rapid tasking of C4ISR with virtual, distributed staffs supported by reachback, including a responsive, comprehensive replanning and plan repair capability
- A collaborative, continual planning capability supported by automated tools that allow the individual processes to take place rapidly and in parallel, rapidly allowing force tasking orders to be updated continually rather than daily, including interaction across the full spectrum of considerations for current and future operations
- A planning capability with collaboration and coordination of all critical functions, i.e., operations, sensor management, logistics
- The capability to relate tasking to the central strategy and to keep tasking options open until the time when decisions must be made ("just-in-time" tasking) to achieve maximum flexibility.

The Predictive Planning and Preemption capability supports the objective of speeding up the planning process to the point where we are sufficiently ahead of the enemy so that we can preempt the enemy's planned actions and prevent a confrontation. If confrontation must occur, then this capability is used seamlessly with integrated force management to apply overwhelming, decisive combat power. The critical functional capabilities key to the success of this operational capability are shown in the figure.

Predictive Planning and Preemption *(Continued)*

Limitations: Automated Planning Systems Not Dynamic and Robust; Wargaming Not Integrated With C2; Sensor Tasking and Countermeasures Are "Reactive" to Emergent IW; Failure To Exploit Theater Spectrum as a Theater Weapon; Full up Planning Requires Large, Vulnerable Footprint in Theater; Inadequate Support for Operations Using Tailored Forces; Planning With Coalition and Humanitarian Forces Is Inadequate.



Needed Technologies

Models and Simulations:
- Rapid M&S (Including C3I) for Situation Assessment, COA Analysis
- Fault Tolerant M&S for Mission Preview, Rehearsal, and Training
- M&S for Spectrum Dominance and IW Effectiveness Evaluation

Collaboration Support:
- Distributed Collaborative, Continuous Dynamic Planning
- Virtual Anchor Desk

Automated Processes:
- Automated Nodal Analysis
- Automated Target/Weapon Pairing and Update
- Information Fusion, Cross-Cueing, Tracking

Architecture:
- Easily Deployable, Evolvable/Scalable Plug and Play Architecture

Predictive Planning and Preemption *(Continued)*

Limitations

In contrast to the capability envisioned, we presently have much a more static planning capability. Our automated systems have inadequate planning and forecasting capacity, and little effective on-line planning capability.

Wargames cannot be used as an integrated element of on-line planning. Interfaces between C4I systems and wargames are not yet adequate and wargaming is presently slower than real time when at high resolution, with many entities, and in a complex action.

There is no capability to recognize early indications of information warfare (IW) activity and no anticipatory management to ensure that it is not successful. Options to use IW to "blind" or confuse the enemy are not available with the present planning systems. There are no options proposed that allow a mix of force and IW options. The present planning cycle for sensor tasking and enabling sensor countermeasures is sequential and not anticipatory, and lags operations considerably.

The present planning capability requires staff to be assembled in essentially one location near the operation. The capability to easily distribute the staff and to collaborate with another node is not regularly available. The capability is limited by communications (discussed later in the Grid Capabilities), lack of a distributed, consistent view of the battlespace (discussed in Consistent Battlespace Awareness), and a lack of collaboration tools.

Technologies

Underlying the technologies discussed here are the grid and battlespace awareness technologies, detailed in subsequent sections.

Modeling and simulation (M&S) has the potential to support many aspects of the planning process. The ability to lean forward in the planning process is predicated on a significant "what-if" capability and on an ability to validate the planning alternatives with mission preview and rehearsal. The major areas of M&S required for this capability are rapid, variable fidelity modeling to support complex COA analysis for friendly and adversary forces; distributed M&S for mission preview, rehearsal, and training available at any needed node; models of the use of the spectrum and means to dominate that use; and IW M&S to support planning and responding to IW actions. Models need to be sophisticated with multiple levels of aggregation and tailorable to friendly and opposing forces.

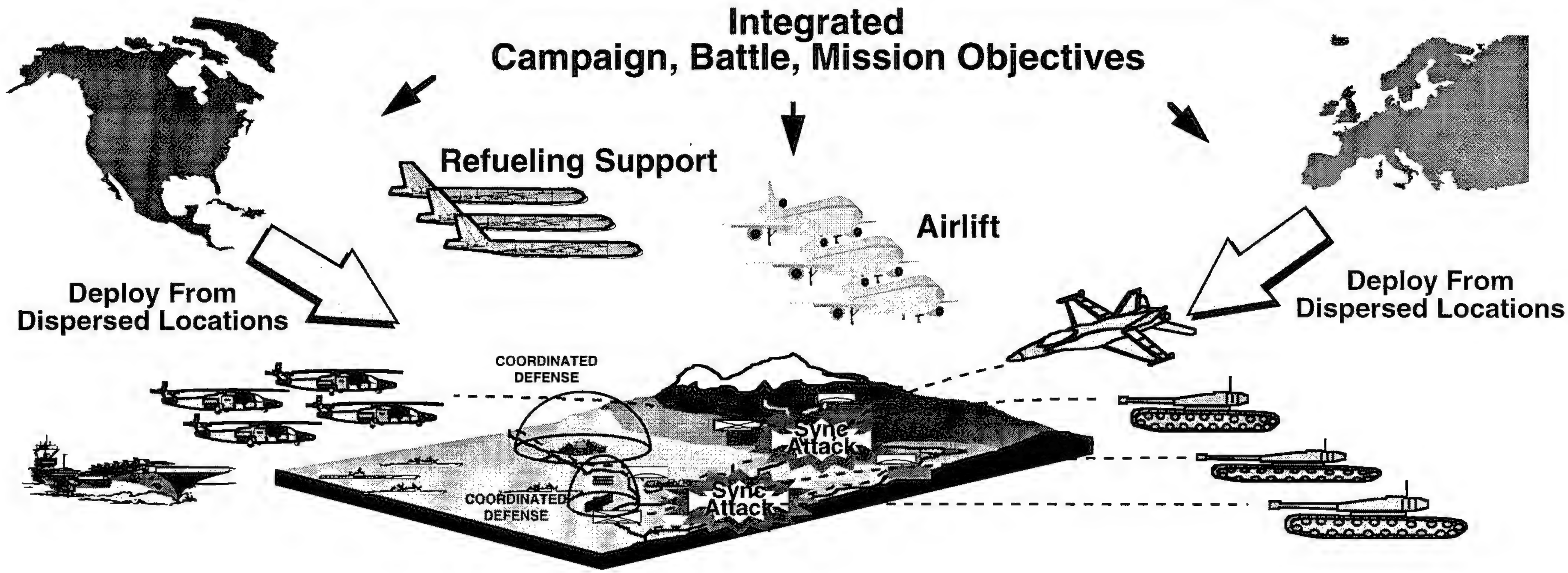
Automated capabilities are needed to not only understand critical nodes in the adversaries' warplan and how those nodes change, but also ensure that the targeting process is identifying the best targets. Also needed is a capability to automatically pair an available and appropriate weapon to targets. This pair needs to be monitored and updated if things change. As updated information becomes available, it must be provided to the weapons. These processes need to be automated to speed up the planning process and to aid planners. Decision aids to support continuous planning and mission package construction are needed to allow planners to meet tight timelines in a responsive planning process and replan based on frequent status updates. These technologies need to include temporal, spatial, and constraint-based machine reasoning.

The evolving plan will be distributed to all participating nodes with elements responsible for different aspects of the plan but the total plan available to all participants. Dynamic planning, scheduling, target handoff, and automated weaponeering and pairing off-load manually intensive processes and allow the planning to be more responsive. Being able to plan while taking into account support, operational, and intelligence functions ensures a supportable approach. The tools, interoperability and connectivity, and ability to bring in team members of a planning process without removing them from their regular job sites are needed. The final challenge will be to extend planning to support force projection. Although the grid will provide connectivity and services, additional automated tools will need to be tailorable for widely varying force packages.

For the planning system to be able to respond to a variety of missions, force mission packages, and environments, the planning system needs to be premised on an architecture that will deploy as needed, evolve both in underlying technology and in functionality, plan for both major regional contingencies (MRC) and lesser regional contingencies (LRC) as well as humanitarian actions, and allow different nodes to be a part of that planning as appropriate to the activity.

Integrated Force Management

Goal: Dynamically Synchronize Force Operations by Collaborative Execution Monitoring, Repair, and Retasking of Shared Assets Across Echelons, Missions, Components, and Coalition Forces.



Critical Functional Capabilities

- Support Simultaneous Engagement and Coordinated Operations
- Mission Rehearsal/Embedded Training
- IW and Spectrum Dominance Monitoring, Planning, and Execution
- Dynamic Tasking Tied to Central Strategy Throughout the Joint Force
- Joint Force Automated ROEs
- Repair and Consumables Management
- Command Projection
- Force Status and Execution Following
- Rapid, Accurate Targeting
- Rapid, Accurate BDA
- Precision Positioning and Timing

Integrated Force Management

Integrated Force Management includes all functions involving management and execution of forces in response to the plans and tasking orders that result from the planning function. The principal elements of the future Integrated Force Management concept are as follows:

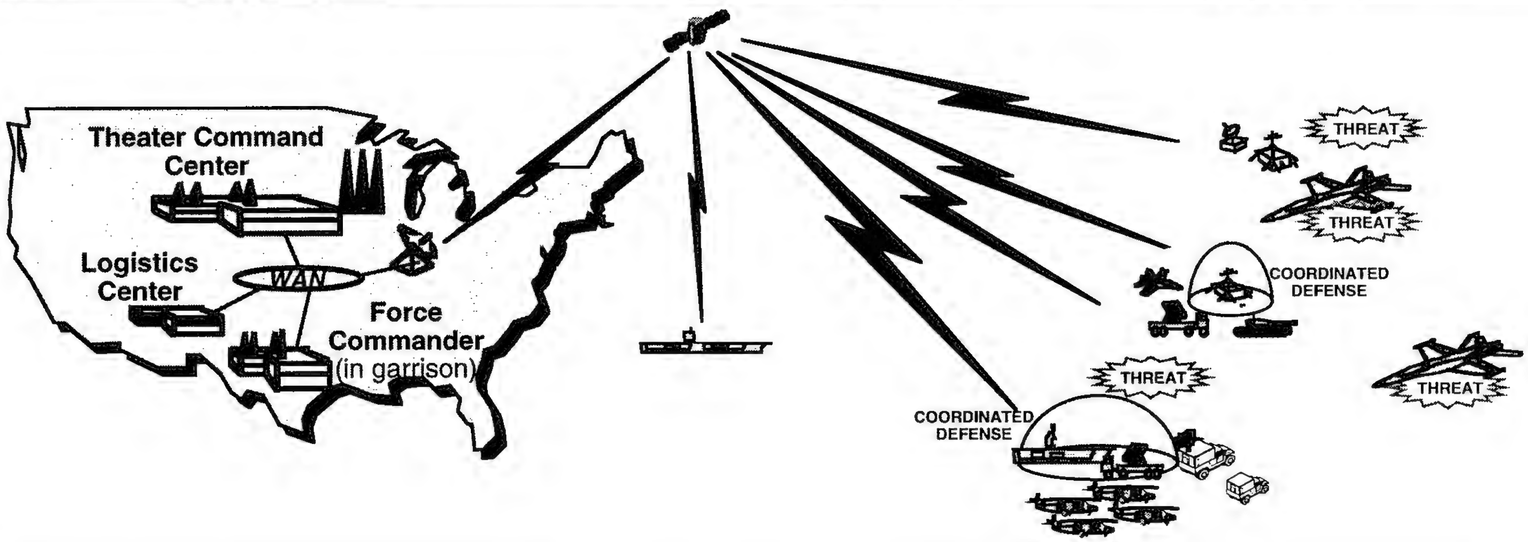
- Simultaneous operations to achieve multiple objectives, synchronized and self-synchronized attacks to produce overwhelming, decisive combat power, and coordinated, integrated defense
- Operations with agile, dispersed formations from dispersed locations for increased survivability against enemy precision forces
- The concepts of "intuitive command" and "distributed empowerment," force coherence, and application of combat power achieved through (a) consistent understanding of the situation and commander's intent and a common strategy and (b) automated rules of engagement, rather than traditional controls
- A dynamic battlespace management capability to respond rapidly to situational changes in time and space with retasking and rehearsal "on-the-move."

The precision timing required to achieve simultaneous operations applies to not only the attack and defense forces but also the supporting forces, including ammunition, fuel, food, medical, and other logistics items, i.e., at the right place at the right time.

The critical functional capabilities key to the success of this operational capability are illustrated in the figure. These capabilities will allow U.S. forces to sustain superiority in the presence of adversaries with access to precision weapon technology while minimizing friendly losses.

Integrated Force Management *(Continued)*

Limitations: Limited Common Situation Understanding and Perception of What Needs To Be Done (Strategy, Commander's Intent) and the Relationship of Individual Tasks to Overall Campaign Objectives; Limited Real-Time Insight Into Plan Execution; Present Coordination and Control Via Rigid Framework of Battlefield Geometry; Limited Ability To Apply All Assets To Formulate and Support Coherent Defense; No Responsive Way To Dynamically Retask High-Value Targets Across Missions and Services in Response to Changing Situations, and Opportunities; Inadequate Ability To Translate Data Into Full Situation Understanding; Planning Is Manually Intensive.



Needed Technologies

Models and Simulations:
- Rapid M&S, Including C3I

Cognitive Support:
- Uncertainty Visualization and Management

Collaboration Support:
- Distributed, Collaborative, Continuous, Dynamic Planning, and Scheduling
- Distributed, Collaborative, Virtual Workspaces
- Virtual Anchor Desks

Automated Processes:
- Automatic Target and Infrastructure ID
- Automatic Target Behavior and Change Detection
- Automated BDA
- Multisensor and Information Fusion
- Automated Nodal Analysis and Weaponeering
- Speech and Text Understanding

Integrated Force Management *(Continued)*

Limitations

Many warriors in a given battlespace currently do not know well many characteristics of that battlespace. The lack of cross-service and intraservice common understanding forces the use of rigid battlespace boundaries (e.g., air operations time/space corridors, fire support coordination lines, sectors of operation) to ensure coordination and prevent fratricide. Because of the need to maintain strict separation, the best mix of assets cannot always be applied, which can be especially limiting in a defensive response. For defensive actions, the response time requirements are most severe and the inability to apply optimal resources is most critical.

Presently, understanding of the battlespace is fragmented with individual command nodes each knowing part of the situation. In addition, the overall strategy and the commander's intent are not ubiquitously distributed. The contribution of individual tasks to that intent is not clear to all participants. These limitations lead to missed opportunities and unnecessary activities. Thus, responses to a dynamic situation can occur without the proper context for determining that response. This situation inhibits "empowerment" of subordinates and full use of initiative at each level of command, as well as slowing speed of command.

For those involved in the real-time implementation of the plan, there is little capability to dynamically respond to changes because the overall plan development is too manually intensive to allow update. Another limiting factor in force management is the inability to see clearly, in real time, how the execution of the plan is progressing. The lack of an ability to dynamically adjust the execution results in missed opportunities, and high-value assets often are not brought to bear where they could do the most good.

Technologies

Integrated Force Management requires improvements to models and simulations, cognitive and visualization support to the warfighter, collaboration support tools, and automated processes. Many of these capabilities are similar to those discussed in Predictive Planning and Preemption and in Consistent Battlespace Understanding. A capability specific to Integrated Force Management is the need for extremely fast and robust tools. The tools need to be fast to support the operational tempo, and robust to deal with the incomplete and inaccurate information that will continue to plague us even with the many proposed advances. Decision support to rapidly propose alternatives with associated issues and contingencies will need to be very sophisticated to deal with the complexity of these situations and the multitude of alternatives.

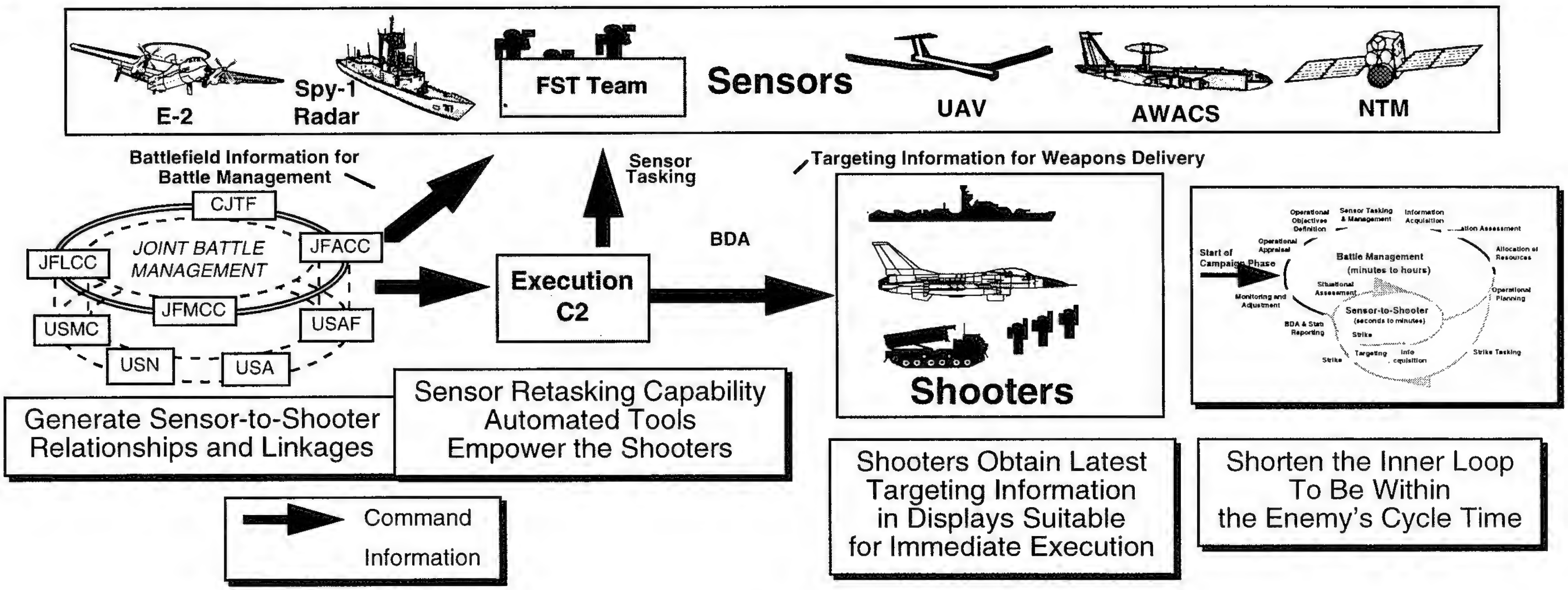
Models and simulations will need to be many times faster than real time to provide evaluations of multiple alternatives and often assessments of risks associated with each alternative. Once the mission decisions are made, M&S is needed for on-the-move mission repair and options assessment. Because it is expected that the overall time cycle from planning to execution will be significantly shorter, mission preview and training will need to be effective, efficient, and conducted in the field. Widely distributed, immersive simulation has the potential to support these requirements.

The cognitive support technologies are intended to provide knowledge and information rather than data to the decision maker. Better means to present complex, time-varying, 3D situations are needed. Cognitive support is an area where there is an opportunity to capitalize on commercial technology advances.

The processes to be automated are those that are computationally intensive. In the past, the processes have been largely manual. The continued expansion of computing power and advances in machine reasoning and learning bring the potential to automate many complex processes within the ABIS time frame. The coordinated defense mission requires many of the same technologies but with increased speed and precision (e.g., maintain ID, monitor target behavior, and fuse information for hundreds of threats with 2-second update rates).

Execution of Time-Critical Missions

Goal: Provide Dedicated Force Packages of Shooters With Sufficient Timely and Relevant Information To Enable Successful Prosecution of Time-Critical Targets.



Critical Functional Capabilities

- Theater Intelligence Processing for Broadcast
- Rapid, Accurate Targeting
- Rapid, Accurate BDA
- Automatic Mission-to-Target and Weapon-to-Target Pairing
- Shared, Dynamic, Distributed, Continuous Collaborative Planning
- Force Status and Execution Following
- ISR and C3 System Management and Integration

Execution of Time-Critical Missions

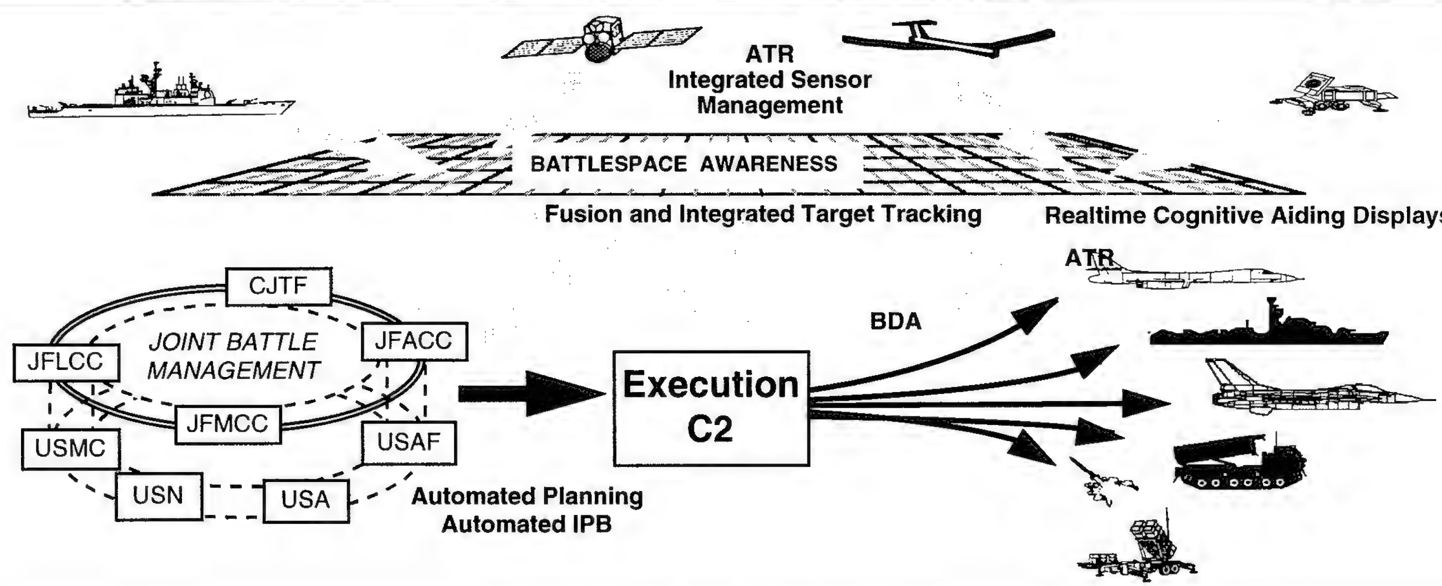
Execution of time-critical missions is the key operational capability for the Sensor-to-Shooter Concept. In most respects, this capability is a special case of Integrated Force Management because it deals with the management of the forces but only those cases with high-value, time-critical targets. The principal elements of the concept are (1) information flows from all appropriate sources, including the grid, directly to battle managers and executing elements, thus bypassing potential delays associated with hierarchical distribution, and (2) executing elements are empowered to take actions, such as shoot and/or task sensors, within bounds of time, space, and rules of engagement as established by battle managers.

As shown in the figure, sensors will continually add information to battlespace awareness databases while executing elements (shooters and controllers) and battle managers will simultaneously be able to extract information. With the black arrows indicating command and the other arrows indicating information flow, the figure shows that future operations will separate the information flow from the command hierarchy. While the battle manager is seeking battlefield information throughout the entire battlespace, the shooters are seeking targeting information. This means that the shooter needs target location and identification, situation awareness in the target area, and clearance to shoot. Currently, shooters do not have adequate situation awareness in the target area. The connectivity and access achieved through implementation of ABIS, through the grid, will provide situational awareness, thus enabling shooters to execute the sensor-to-shooter operations successfully. Today's conflict of competing sensor tasking for the same geographic area will be resolved to a significant extent by using integrated sensor management techniques.

As indicated on the left of the figure, battle managers will plan and determine the overall central strategy and will set up the environment and rules under which the execution C2 will operate. Using automated tools for sensor tasking, targeting, weapon-to-target pairing, and battle damage assessment, the execution C2, in the figure's center, will empower the shooters to take specified action. As shown to the right, the shooters will obtain the latest targeting information providing rapidly comprehensible displays for immediate execution. In this manner, the inner sensor-to-shooter timing cycle is reduced to be within the enemy's cycle time. The critical functional capabilities key to the success of this operational capability are shown in the figure.

Execution of Time-Critical Missions *(Continued)*

Limitations: Targets Appear After Force Package Commitments, Pop-Up Targets, Movement Cycles; Execution Status Unknown; Inability for Timely Counteraction to Target Reaction; Inadequate Coordination; Battle Management Reluctant To Release Information; Different Information Needs for Different Users; Simultaneous Pulls on Sensors; Insufficient Connectivity; Lack of Sensors; Man-Intensive BDA; Sensor Management Not Tied to Commander's Intent.



Needed Technologies

Automated Processes:
- Multisensor Fusion, Cross-Cueing, Tracking
- Automatic Target and Infrastructure Recognition
- Automated Intelligence Preparation of the Battlespace

Collaboration Support:
- Distributed, Collaborative, Virtual Workspaces

Cognitive Support:
- Cognitive Displays With Real-Time Presentations
- Distributed, Collaborative, Continuous Automated Planning
- Cognitive Support and Decision Support Tools

Execution of Time-Critical Missions *(Continued)*

Limitations

Time-critical missions require a rapid response of sensors, shooters, and execution command and control to detect, identify, and engage fleeting, high-value targets. Special-purpose connectivity and special sensor tasking have been implemented, in isolated cases, to provide better support against fleeting targets, but this capability is not available in general and not available for all appropriate sensors and shooters.

Present systems make it difficult to deal with changes after the force package has been committed, which precludes responding to many of the situations encountered, such as popup targets. Also, once forces are committed, the adversary can adjust to the ongoing execution, with the result that the planned execution approach may no longer meet the needs of the mission.

Execution status data does not rapidly and automatically get back to the C2 nodes because of a lack of connectivity and a lack of interoperability. Additionally, the information flow from battle managers to execution nodes is constrained. Battle managers are sometimes reluctant to release information for fear of compromising the information. These factors and others lead to inadequate coordination between the force element and the C2 nodes.

Sensor limitations and limitations in the processing of sensor data continue to be a problem. There are limits to the efficiencies that can be achieved because of the need to process sensor data differently for different users and the simultaneous needs for the sensor that simply cannot be accommodated. Also, the sensors are not connected to all the users that need the sensor data. The present decision and resource allocation process is not able to respond to the needs of those who are executing the mission. The need for decision support is a common theme in the ABIS operational capabilities, but it is intensified in mission execution. Not only do critical decisions need to be made rapidly, but it is also a challenge to understand how best to collaborate on and present those decisions. There is more demand for sensor data than there are sensors to provide it. More efficient use of sensors will improve the situation, but more sensors are needed.

Fleeting targets are difficult to detect. Present systems have difficulty recognizing the targets. Specific recognition is required for systems to automatically provide additional coverage and sensor cross-cueing. There are many entities in the battlespace and discrimination between entities is presently too slow a process to support the needed timelines. Additional detection capability would be provided if the output of all the relevant sensors could be integrated, but present fusion processes are slow and often manually intensive.

The present battle damage assessment (BDA) process is manual and slow. BDA should be completed in time to retask weapons while the target is still at risk. Immediate BDA cannot be supported by a manual process.

Today sensor management is not an integrated, cross-sensor function synchronized with the commander's intent. Often the sensor managers do not have a clear picture of the commander's intent and they may have other, more immediate demands to which they need to respond.

Technologies

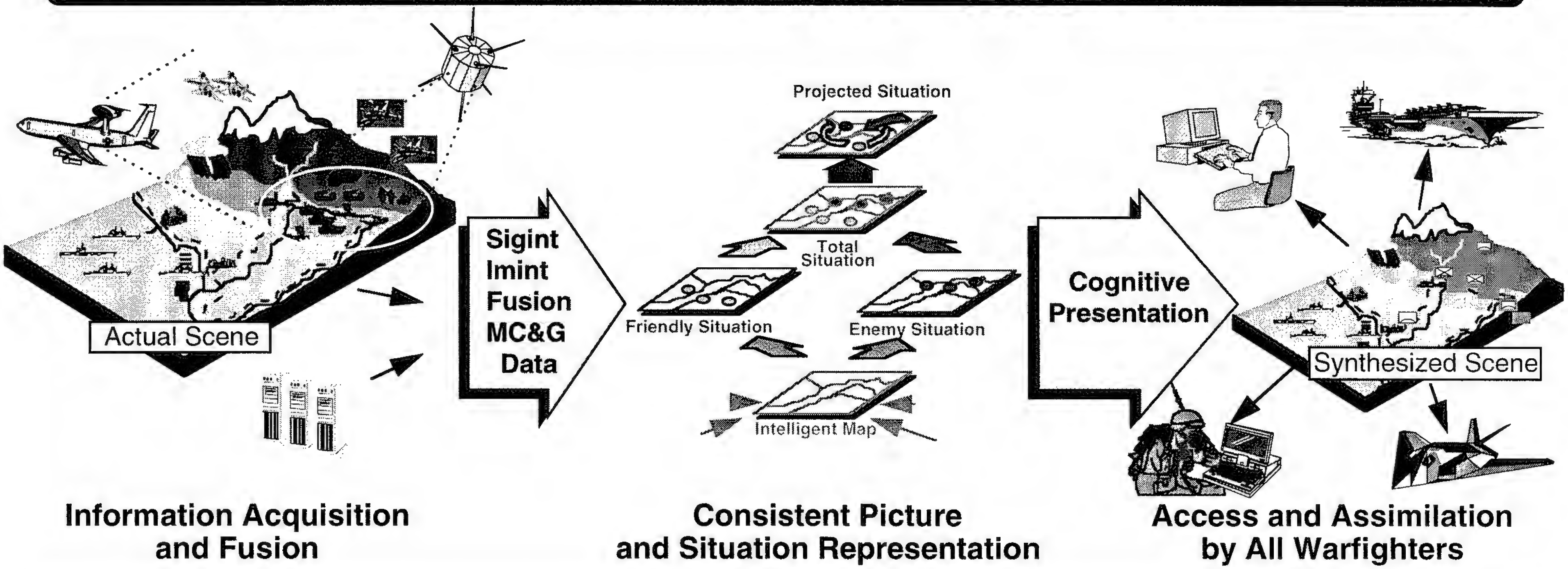
Technology improvements are needed to automate processes to meet the stringent timeline requirements, provide interoperability, and facilitate understanding of the information. Many of the needed improvements can provide support to multiple operational capabilities. Good information distribution requires connectivity, interoperability, and an ability to exchange information at various levels of classification. These three areas are highlighted in subsequent figures of Grid Capabilities.

Not only does the planning and decision process need automated support to achieve the needed timelines, but the overall intelligence preparation of the battlespace (IPB) process needs automated support for tasking of sensors, processing sensor data, and disseminating the products. The ability to fuse the available data and automatically recognize targets will require significant advances. These problems have been worked for several years, and some progress has been made, but continued technology advances are needed. Intelligence, surveillance, and reconnaissance (ISR) management is discussed in the Precision Information Direction operational capability. Collaboration to support time-critical missions to get proper sensor support will be required and direct sensor management will, at times, be turned over to the execution forces.

Real-time cognitive aiding displays become critical in the case of complex, dynamic situations in which decisions are being made, frequently under great stress. Such displays are needed for the control nodes of the execution to understand and react to numerous simultaneous missions. Such displays are also needed in the tank/cockpit where the mission is being carried out. The needs of the users vary and the specific displays and technologies likely will have to be different.

Consistent Battlespace Understanding

Goal: Elevate the Level of Cognitive Understanding of the Friendly, Enemy, and Geospatial Situation; and Maintain Consistency in That View Across Tactical and Supporting Forces.



Critical Functional Capabilities

- Intelligence Processing for Broadcast - National and Theater
- Intelligent, Distributed MC&G
- Collaborative Situation Assessment, ATR and BDA
- Common Understanding Representation, Including Commander's Intent and Access and Assimilation by All Warfighters
- Situation Projection, Force Status and Execution Following
- Parallel Dissemination of Intelligence/BDA to C2 and Shooters
- Rapid, Accurate Target Information (Target Location and Recognition, Situation Awareness in Target Area)

Consistent Battlespace Understanding

Consistent Battlespace Understanding includes all functions involving the collection of relevant data and intelligence, the fusion of that information, the incorporation of that information into a consistent, layered situation representation, and the cognitive presentation of that representation in a way that can be accessed and assimilated by all warfighters from commanders to shooters. The principal elements of the future Consistent Battlespace Understanding concept are as follows:

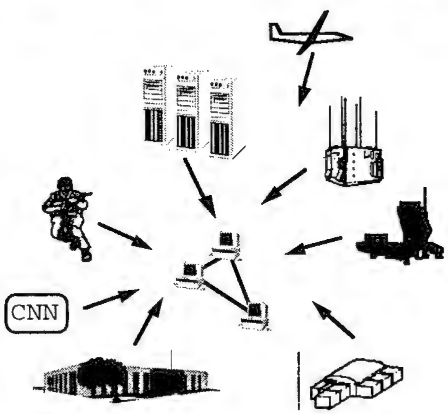
- Automated gathering of all relevant information from global databases; national and theater sensor systems; friendly plans, force readiness and status; and MC&G sources using grid assets such as networks, databases, and intelligent agents for smart search
- Merging this information into a consistent, layered representation for situation assessment
- A cognitive, interactive presentation with varying degrees of aggregation, for access and assimilation by warfighters but customized by them for the information that they need.

Although information appears to be moving from left to right in the figure, it should be stressed that the entities on the right and the left are both receivers and sources of information.

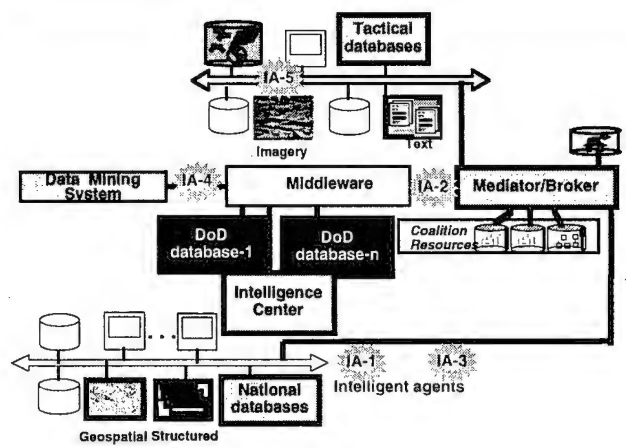
This concept can also be viewed from the perspective that the warfighter is provided rapid access to total understanding of all the information that exists relevant to his needs, uninhibited by the information system itself. The critical functional capabilities key to the success of this operational capability are shown in the figure.

Consistent Battlespace Understanding *(Continued)*

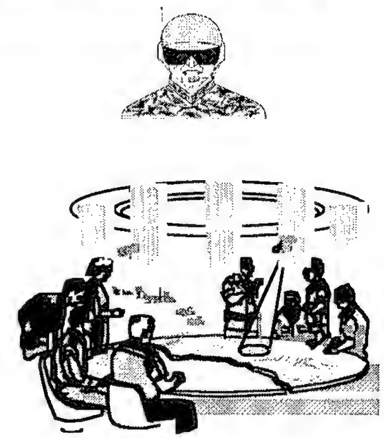
Limitations: No Common Operational Picture, Inadequate Information to Support Decisions, Information Without Quality Thresholds, and Text Messages Without Automatic Machine Understanding; Intelligence Preparation of the Battlespace Degrades When Battle Begins.



Information Acquisition and Fusion



Consistent Picture and Situation Representation



Accessibility and Assimilation by the Warfighters

Needed Technologies

Automated Processes:
- Automatic Target Recognition and Battle Damage Assessment
- Multisensor and Information Fusion and Sensor Cross-Cueing
- Image Understanding and Pattern Recognition
- Speech and Text Understanding
- Recognition, Routing, and Analysis of Data

Data Storage and Retrieval:
- Intelligent Agents for Retrieval, Filtering, and Deconfliction
- Agents for Intelligent Inference
- Real-Time Distributed Object Management
- Automated Data Validity Tags

Models and Simulations:
- Rapid M&S for Situation Assessment and COA Analysis

Cognitive Support:
- Intelligent Object-Oriented Maps
- Distributed, Collaborative, and Virtual Workspaces
- Uncertainty Management and Visualization
- Cognitive Support and Decision Aids
- Cognitive Displays, Virtual Reality, 4D Real-Time Presentation

Consistent Battlespace Understanding *(Continued)*

Limitations

The lack of a common operational picture has many causes. Currently friendly plans and execution status are exchanged only among some participants, and that exchange is limited in dissemination both by echelon and by service. The enemy force picture is available in bits and pieces in stovepiped and compartmented systems leading to inconsistent perspectives of the situation. The mapping products to provide a common perspective for the forces and plans are difficult to access, especially in certain areas, and these products are not responsive to a dynamic environment.

Commanders need this common operational picture, supplemented by an ability to project the situation to explore both enemy and friendly alternatives. In addition, the information must have a certain minimal level of quality (timeliness, accuracy, resolution) to be useful to support decisions. Presently, that quality is not assured and an ability to aggregate and deaggregate to view the situation at the appropriate resolution is not provided.

The exchange that does take place is usually by text message and does not easily support a consistent battlespace understanding. Automated, consistent, machine understanding of message text, which would allow the information content to be extracted and used in analyses/projections, is not available. Because the message exchange is hierarchical, requires retransmissions, and is often taking place in a saturated communications environment, there is little chance that the information will reach all warfighters. The present IPB process is manual and lacking the tools with which to deal with a dynamic environment. The ability to get sensors focused in needed areas to update the IPB is suboptimum, and the various intelligence nodes have limited ability to collaborate and exchange information.

Technologies

Many advances in technology and its application are required to provide consistent battlespace understanding. These technologies range from machine reasoning to automated complex processes to displays capable of presenting time-varying, complicated, 3D situations.

Communications connectivity does not support the physical exchange needed, although the emerging broadcast capabilities look promising. (See the Grid Capabilities discussions, following Precision Information Direction, for details on the types and extent of connectivity and services required to support all the operational capabilities, including the Consistent Battlespace Understanding capability.)

Automating complex manual processes, such as image processing/target ID and fusion of data and information from multiple sources, requires machine reasoning and other sophisticated artificial intelligence techniques. Although the progress has been slow, progress is being made in these areas with the potential to significantly improve the timeliness, accuracy, and consistency of many products. For human interoperability, we need the ability to communicate to others in any language, especially to our coalition partners. Automated language translation is a future capability that would enable this. A nearer term technology is the ability for the systems to understand text rather than data to allow text messages to contribute to the system's presentation of the situation.

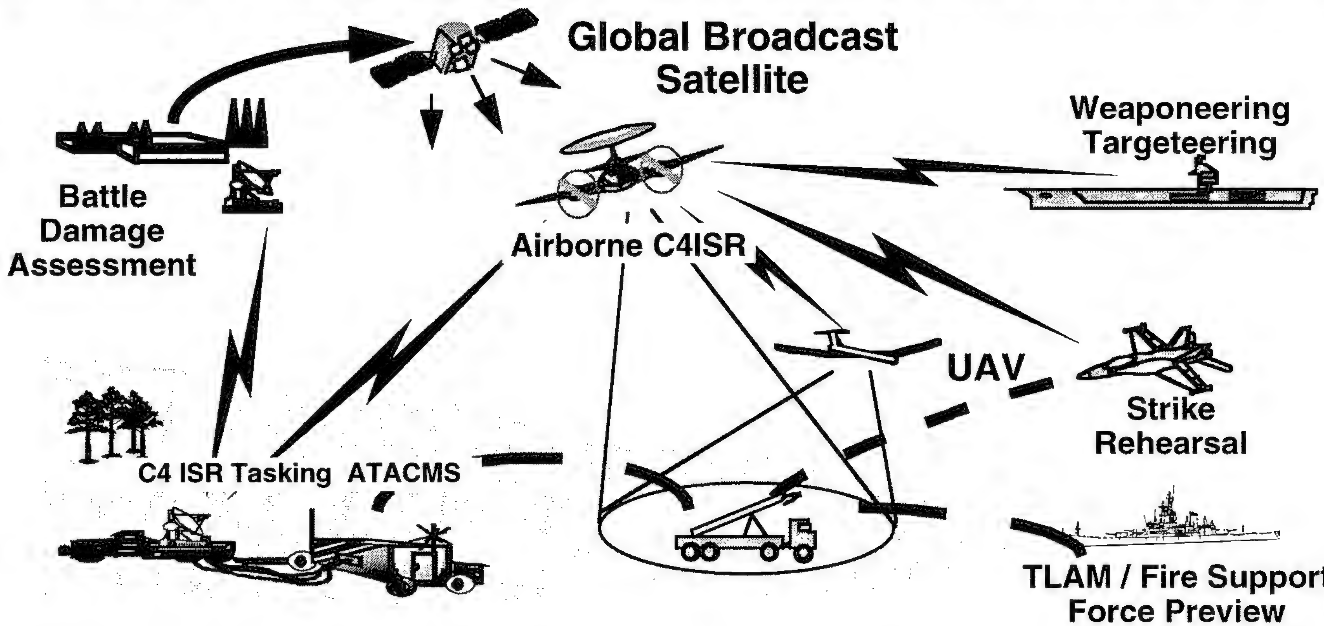
Ability to store and retrieve massive volumes of information efficiently includes advances in storage, ability to synchronize information, and the means to quickly search for specific information and intelligent agents that can act on behalf of a user. The intelligent agent technology provides intelligent computer programs that can navigate through networks to databases to identify information, negotiate for it, resolve conflicts with related information, and return the information to the requester. Agents will also reside in the grid as a part of that infrastructure to provide a general purpose capability. As we process massive amounts of information from a distributed set of sources, we will need an ability to define and tag the quality of the data so that it can be used appropriately. Presently, data is tied to a particular system that is designed with the data's quality understood. When dealing with data from varied sources, tags will be needed to provide the information about the data's source and errors to allow the systems to process the data correctly.

Models and simulations support the exploration of alternatives both to understand better what the situation might be today and how it may unfold in the future. This requires real-time simulation that models both enemy and friendly C4I, which is not available. Virtual reality uses models and simulation to project a three-dimensional environment that would allow commanders to immerse themselves in the situation as it is understood.

Cognitive support and decision aids are needed to aggregate and synthesize the data to provide knowledge and understanding to the commanders and decision makers at all levels. Advances in display technologies are required to support the needed displays. Both the presentation of complexity and uncertainty need improvement, as does the ability to aggregate and deaggregate, and present detailed and low resolution information simultaneously.

Precision Information Direction

Goal: Enable the On-Scene Commander To Exploit and Shape the Battlespace by Dynamically Directing and Integrating C4ISR Resources for Targeting, Weaponeering, Mission Preview, BDA, and Combat Assessment.



Critical Functional Capabilities

- Intelligence Processing for Broadcast, Both National and Theater
- Shared, Dynamic, Distributed, Continuous Collaborative Planning
- ISR and C4 System Management
- Rapid, Accurate Targeting and BDA
- Mission Rehearsal and Embedded Training
- IW and Spectrum Dominance Monitoring, Planning, and Execution

Precision Information Direction

Precision Information Direction includes all functions involved in dynamic control of information resources and the integration and delivery of mission information products to facilitate effective employment of forces. The principal elements of the future Precision Information Direction concept includes the following:

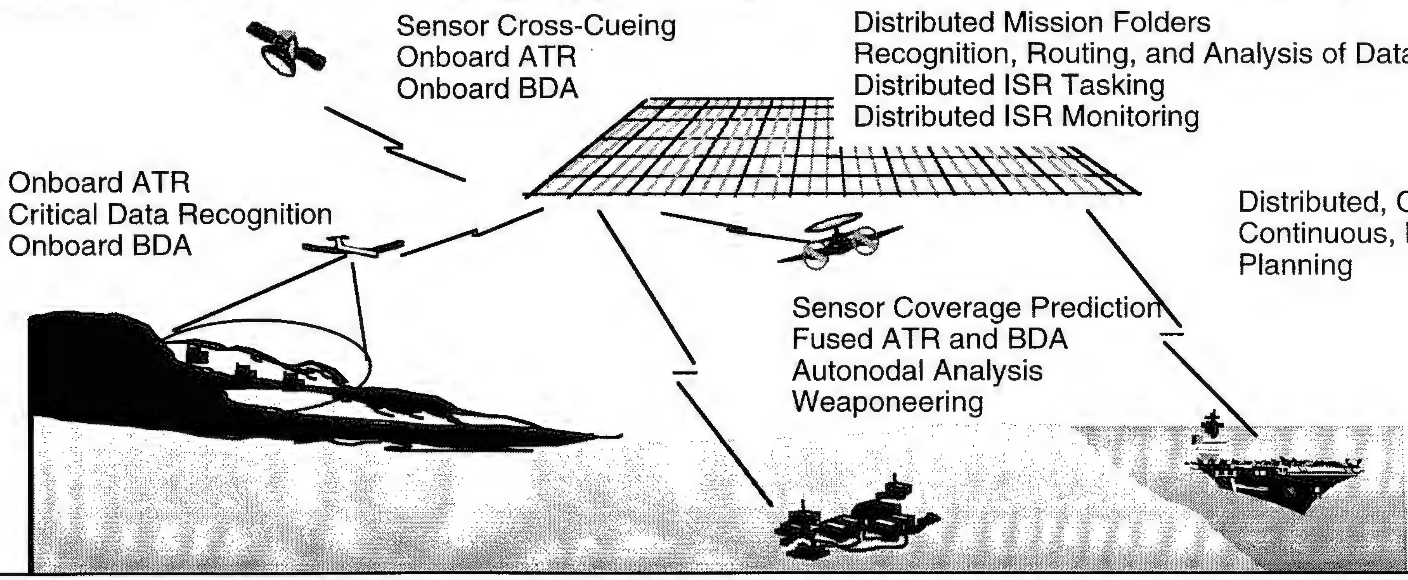
- A distributed, collaborative function of system management of C4ISR resources for support of in-theater commanders. This function provides visibility into the capabilities of the total national and theater complement of C4ISR resources available, such as national sensors, theater airborne reconnaissance, UAVs, AWACS, and Joint STARS and provides capability to task them either directly or indirectly. Precision Information Direction has the capability to predict sensor performance, and working with Consistent Battlespace Understanding and Predictive Planning and Preemption, to predict the payoffs associated with application to different missions. Thus, it can determine the most efficient application of these resources, in time and space, in support of in-theater commanders. The commanders, in turn, can plan their missions to best use these resources, which includes synchronization with strike assets to facilitate shoot-look-shoot strategies in the execution of time-critical missions.

- The integration and synchronization of information from these resources and other sources into mission products, which have up-to date information, will be delivered just-in-time to the warfighter. This includes distributed analysis for target development, weaponeering, bomb damage, and combat assessment as well as visual aids and support for mission preview.

The Critical Functional Capabilities key to the success of this operational capability are shown in the figure.

Precision Information Direction *(Continued)*

Limitations: Limited Response to Rapid Battlespace Changes, Rigid ISR, Lack of Theater Visibility Into Sensor Tasking and Coverage; Limited Ability To Keep Stressing Targets at Risk; Limited Comprehensive Sensor Tracking and Sharing/Coupling of Operations To Support Campaign Missions; No Just in-Time-Retargeting Capability; Sortie Impact Limitations, Poor and Slow BDA.



Needed Technologies

Automated Processes:
- Automatic Target Recognition (ATR)
- Multisensor Fusion and Sensor Cross-Cueing
- Automatic Nodal Analysis
- Automated BDA
- Automatic Recognition, Routing, and Analysis of Data

Models and Simulations:
- M&S for Spectrum Dominance and IW
- Rapid M&S for Sensor Coverage Analysis

Architecture:
- Easily Deployable, Scalable Evolvable, Plug-and-Play Architecture

Execution Management:
- Distributed, Collaborative, Continuous, Dynamic Planning
- Distributed Collaborative Virtual Workspaces
- Intelligent Agents for C4ISR Tasking

Cognitive Support:
- Uncertainty Management and Visualization

Precision Information Direction *(Continued)*

Limitations

Recent exercises have begun to explore new means of using existing sensors. These exercises, which stemmed from Desert Storm experiences, have revealed that considerable work remains to be done. The present ability to perform sensor tasking is limited in terms of the ability to understand the sensor tasking and coverage situation, and the ability to respond to the dynamic situation by reallocating sensor resources to be more effective. The sensor tasking is rigid and lacks an ability to consider multiple sensors, multiple sensor modes, and alternative means to satisfy information needs.

The sensor tasking shortcomings lead to an overall limitation of abilities to continue to stress targets (hold at risk) over a period of time. The inability to satisfactorily recognize and focus on high-value targets that are susceptible to attack means that the targets are much harder to eliminate and critical opportunities are lost.

Individual sorties need near real-time BDA, and the sensors have the potential but not the capability to provide BDA for many combinations of weapons and targets. The system also is limited in the ability to schedule BDA unless the target is fixed and preplanned.

High-value missions could be more successful with sensor support before, during, and after the mission. With exceptions, this support cannot be provided with current sensor tasking. There is also little ability to adjust sensor support in near real-time.

Technologies

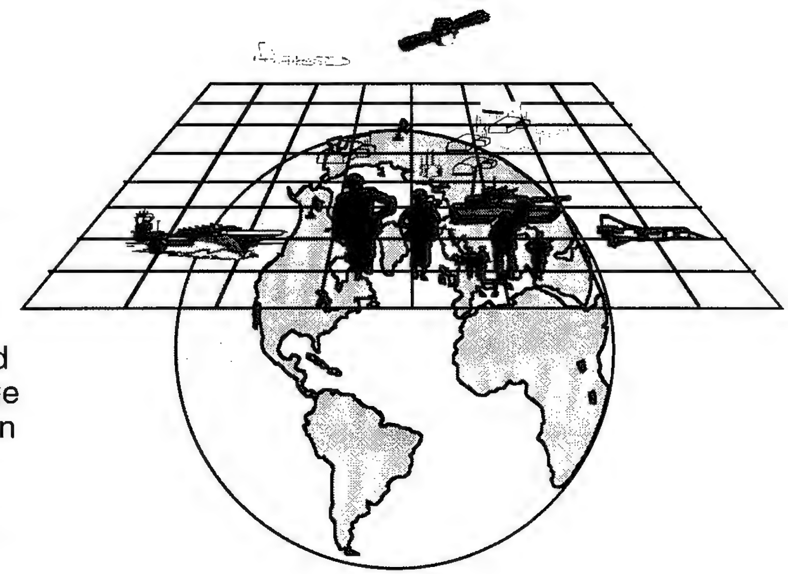
Automating aspects of the sensors, the sensor processing, and the sensor management will improve the responsiveness of existing sensors. Automatic target recognition (ATR) is needed to sort objects in the battlefield and to concentrate efficiently on the critical regions. The ability of sensors to cue other sensors would allow the sensors to request additional information to perform ATR and/or to pass a target to another sensor, which may be better positioned or in a better spectrum to perform the mission. The increased efficiency that is possible by taking advantage of sensor mixes, rather than treating each sensor individually, requires automated aid to recognize the opportunity and the implementation of cross sensor cueing and integrated sensor tracking. An architecture that supports plug-and-play will be needed to realize these capabilities.

Automatic recognition, routing, and analysis of data begins at the sensor and, when coupled with grid capabilities, provides the potential to quickly "push" critical information to the warfighter.

Rapid M&S for sensor coverage would support preplanned "what-if" analysis to support anticipated high-value missions. Additionally, this capability supports the dynamic reassignment of a sensor for a sudden critical mission by allowing alternative sensor locations and alternative sensor modes to be rapidly considered.

The requirements for sensor data will exceed the supply. In addition to planning support, we need collaborative capabilities to allow the experts to participate from any location. A clear understanding of the situation, ISR needs, and ISR resources available will allow sensor managers to provide the best combinations of coverage. Because of the many factors that need to be considered and the need for a team to understand the tactical situation, the plans, and the commander's intent, displays with high-cognitive content and ability to present uncertainty will be needed.

The Grid



- The Effective Force Employment and Battlespace Awareness Operational Capabilities Require a Broad Range of Supporting Information Services
- The Grid Is an *"Information Environment,"* Comprising a Dynamic, Adaptive Set of Mechanisms, Services, Facilities, and Value-Added Functions That Enable Information and Knowledge To Be Developed and Exchanged Among Users and Systems in Support of Their Missions.
- It Is Composed of Federated Systems and Elements That Can Be Configured and Managed To Suit the Commander's Needs
- The Grid Can Be Projected Globally To Support Multiple Operational Areas

The Grid

The capabilities that have been discussed in the previous 10 figures presuppose the existence of the supporting grid services. Each of those operational capabilities requires extensive information services that are ubiquitous. For example, predictive planning and preemption needs sophisticated, adaptive communications connectivity; collaboration tools that extend to small covert, early entry forces; and access to models and simulations.

The features of the grid are essential elements of the ABIS. It is the mechanism by which user-centric information services are achieved and it allows information access to be separated from the command and control process. The grid provides much of the flexibility, reconfigurability, and global reach that are fundamental features in the ABIS Task Force approach.

It is essential to understand that the grid is a full "information environment," which includes advanced information processing, storage, intelligent information management, and value-added services, such as security and network management as well as communications for connectivity. The grid also must be a "federation" of heterogeneous elements rather than a monolithic and centrally owned system. It simultaneously must support multiple missions, probably of different types and in different areas of operation.

The Deployed Warfighter Is Supported by the Grid

Extension of Services to Mobile Tactical Users

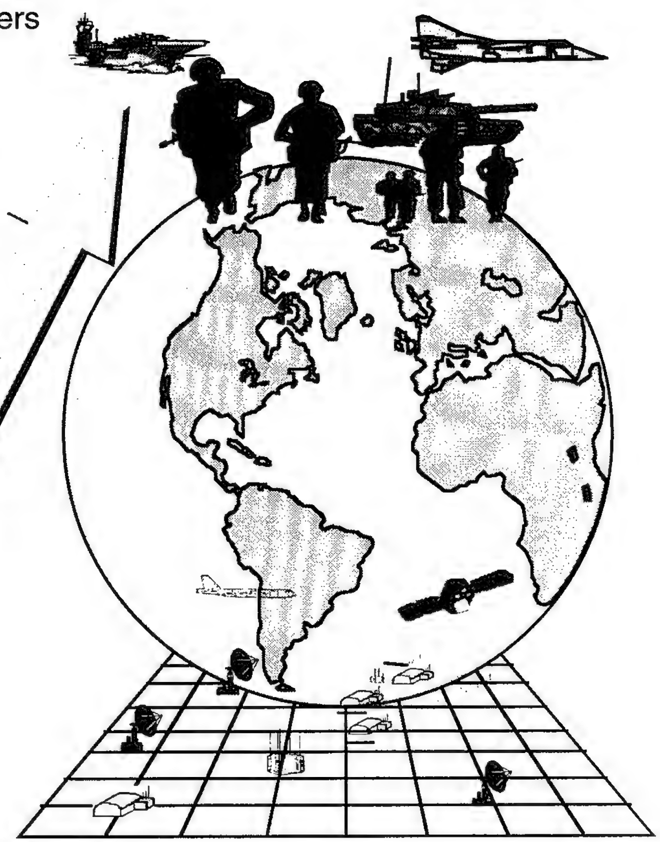
Services for Human-Computer Interfaces
Suited to a Warfighter's Operating Environment

Interoperability and Flexibility To Allow Warfighters
To Form Tactical Action Teams To Fit the Situation

Services To Help Warfighters Find and Retrieve
Information From the Massive, Distributed Environment

Management and Protection of Services
Tailored to the Needs of the Deployed Forces

Full Leveraging of Facilities, Staffs, and Information
Distributed Throughout a Global Infrastructure



The Deployed Warfighter Is Supported by the Grid

The ABIS concept emphasizes the importance of providing high-capability information services to deployed warfighters, and the grid is the mechanism for achieving this objective. The vision is to provide information services that are not diminished when forces deploy and that allow the information environment to be adapted to the warfighters' needs.

This is a major extension from earlier concepts and efforts that have tended to focus advanced information technology on higher headquarters rather than on the forces themselves. Recent advances in communications and computing have made practical a major shift in emphasis from the higher headquarters and static infrastructure to the tactical forces. We are starting to see the military payoff from lightweight portable computers and mobile communications that reached the commercial marketplace only a few years ago. Capabilities are being extended downward into tactical forces in each of the services, and major thrusts, such as the Army's digitized battlefield and the Navy's Copernicus, have become centerpieces of important new initiatives. The goal of ABIS is to accelerate the thought processes and the investments within DoD, to expedite the use of these and future technologies, and to capitalize on the efforts within each of the services and within industry.

The grid provides an information environment that spans all warfighter organizations, from the highest headquarters to the movers and shooters in the field, afloat, under the sea, and in the air. Concepts for warfare in the 21st century will be increasingly demanding of both a high degree of integration in decision making and execution as well as the maximum effectiveness in using available information to leverage the forces. One important aspect is the human interface with the information environment. We need to allow the warfighters to use the kinds of displays and interactive devices that make sense to them within their operational context. The warfighter also needs to have access to the information and services even when on the move or at the "small end of the pipe." A key feature of the grid is the tactical extension of communications and processing to reach these "low-end" users.

Operational concepts for the future envision real-time adaptation of tactical teams to deal with a dynamic battle environment. For example, a specific set of sensors, weapons, platforms, and command posts may be organized into a task team for a specific action. The team may need to persist for several days or it may last only for the several minutes needed to service a particular target. The grid will need to provide flexible and adaptable connectivity and computing services to this shifting set of users, with the appropriate security and access control, even when the team spans coalition forces where language, access privilege, and tactics vary considerably.

Warfighters will also need considerable assistance in dealing with the enormous volume and diversity of information that may be available to help them complete their missions. If information is in the grid but cannot be located, it is useless. The grid will consequently need to provide services that help the warfighters ask questions in their native language and receive answers that include the best knowledge available throughout the networked computers, facilities, and staffs. In addition, the grid will need to be able to broker requests for additional information to the appropriate places for adjudication. These capabilities are particularly critical for deployed tactical warfighters who have neither the time nor the resources to search for information or deal with the adjudication processes.

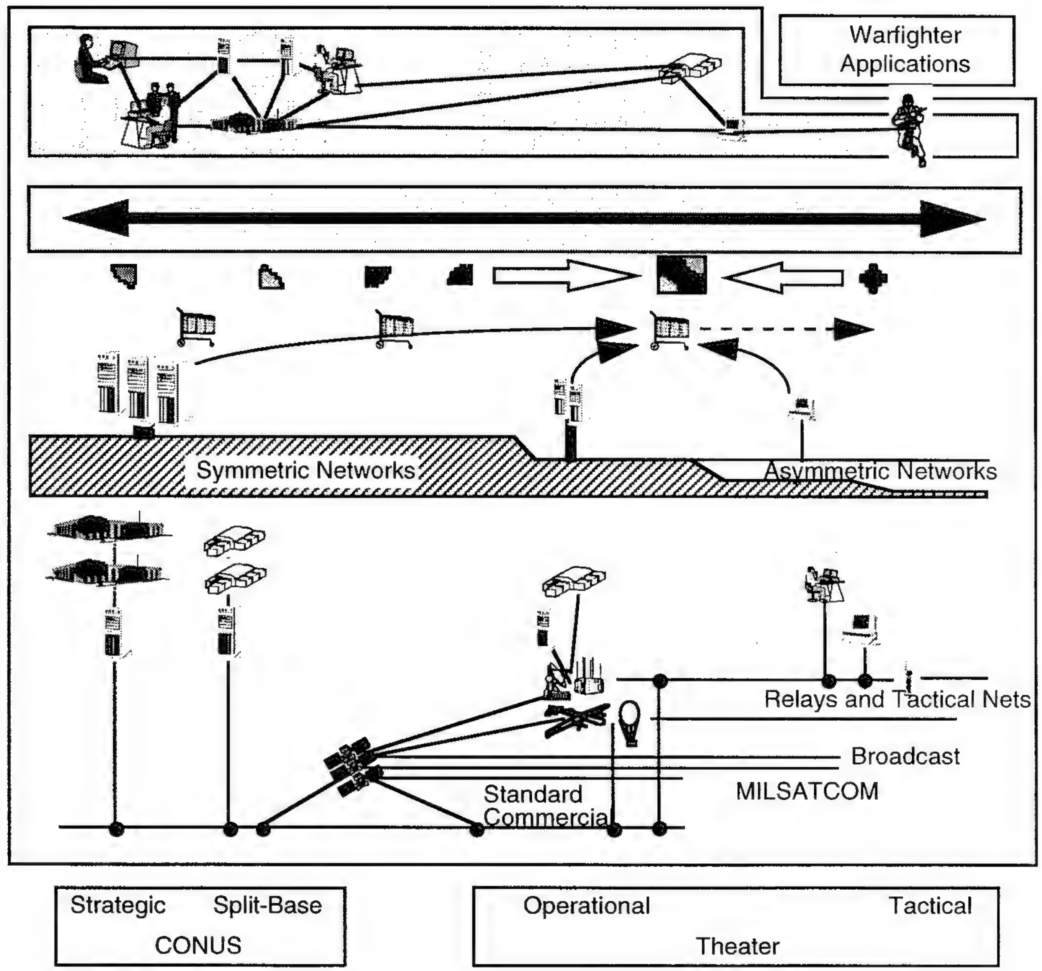
To accomplish all of this, the grid must be managed and defended. We will need to configure services to fit the situation, to project them to any place as needed, and to protect both the system and information from intentional and unintentional disruption. We will need a management system for the grid itself, to provide management and defensive capabilities to counter physical and information warfare threats. Damage under stress will have to be held to a minimum, degradation will have to be graceful, and restoration of capability must be prompt and priority ordered.

A Notional Grid

Applications
- Distributed Virtual "Anchor Desk"
- Distributed "Warfighter's Associate"
- Collaboration Support (VTC, CVWs, Etc.)

Services
- Security and Protection
- Distributed System Management
- Heterogeneous System Services
- Intelligent Information Retrieval
- Information Repositories
- Multimedia Information Transport

Infrastructure
- Software Support Centers
- System Management Centers
- Data Processing Centers
- Tactical Radio Networks
- Airborne Relay Networks
- Satellite Communications
- Terrestrial Communications (Fiber Plus Legacy Wire and Microwave)



A Notional Grid

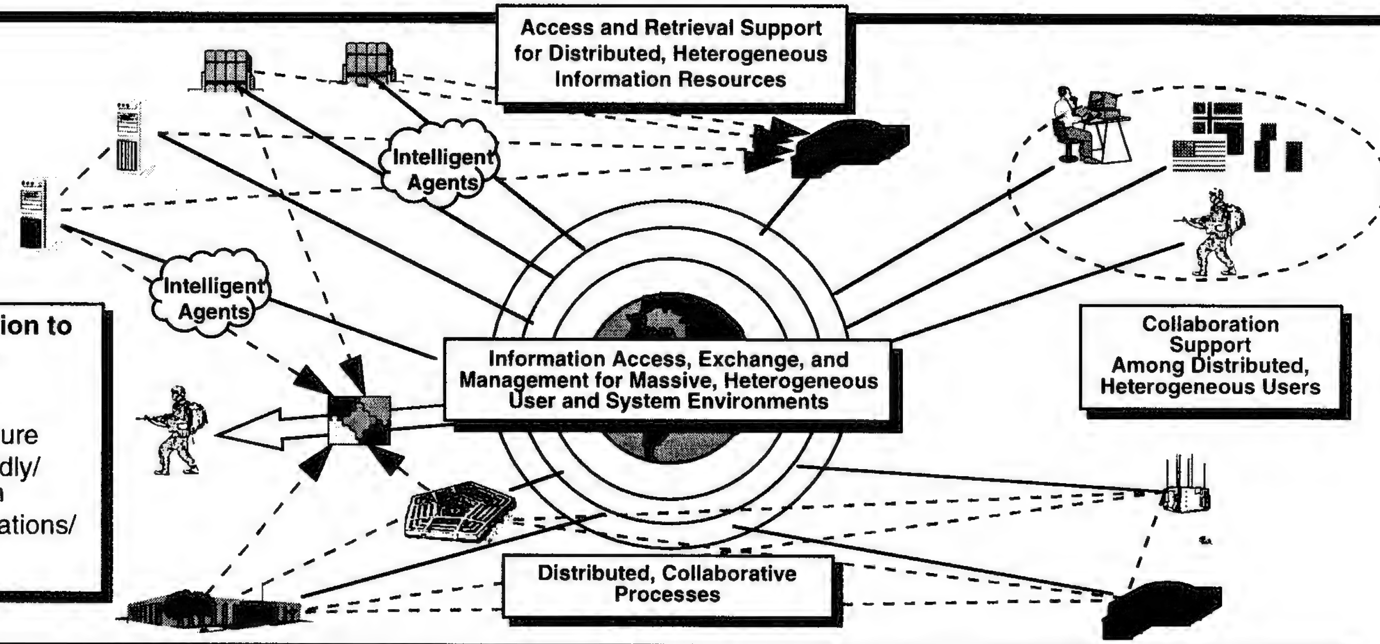
The ABIS grid is a full set of integrated information services, including, but not limited to, communications. There are a variety of perspectives of the grid, such as an information view, a systems view, and a capabilities view that can be examined to understand its full range of elements, services, functions, and capabilities.

The figure shows the grid in three layers: applications, services, and infrastructure. This vantage allows us to illustrate a number of the key elements and services at each layer. In addition, it is important to include in the concept the provision of connectivity and services from the deployed tactical level to CONUS and other areas, both for split-base operations and reachback services. Obviously, a wide variety of computing resources, applications, human-machine interfaces, and types of communications (including mobile) must be interlinked to provide the capabilities envisioned.

As discussed previously under the ABIS capability framework, the grid provides capabilities in three areas: distributed environment support, universal transaction support, and assurance of service. The notional grid construct provides these capabilities through the infrastructure, services, and applications available to all users and can be tailored to their specific needs.

Distributed Environment Support

Goal: Provide Support To Allow Warfighters To Craft Their C4I Information Environments From the Full Set of Assets Connected Through the Grid, Including Distributed Virtual Staffs; Sharing a Common Consistent Perception of the Battlespace; and Constructing Distributed Task Teams Among Sensors, Shooters, Movers, and Command Posts.



The Right Information to a Warfighter When Needed
- Consistent Operational Picture
- Integrated Friendly/ Enemy Situation
- Integrated Operations/ Logistics

Critical Functional Capabilities:
- Support for Sessions With Heterogeneous Users and Interface Modes
- Knowledge-Based Access, Retrieval, and Integration of Information
- Support for Distributed, Collaborative Processes
- Massive, Heterogeneous Distributed Information Management
- Precision Positioning and Timing Services

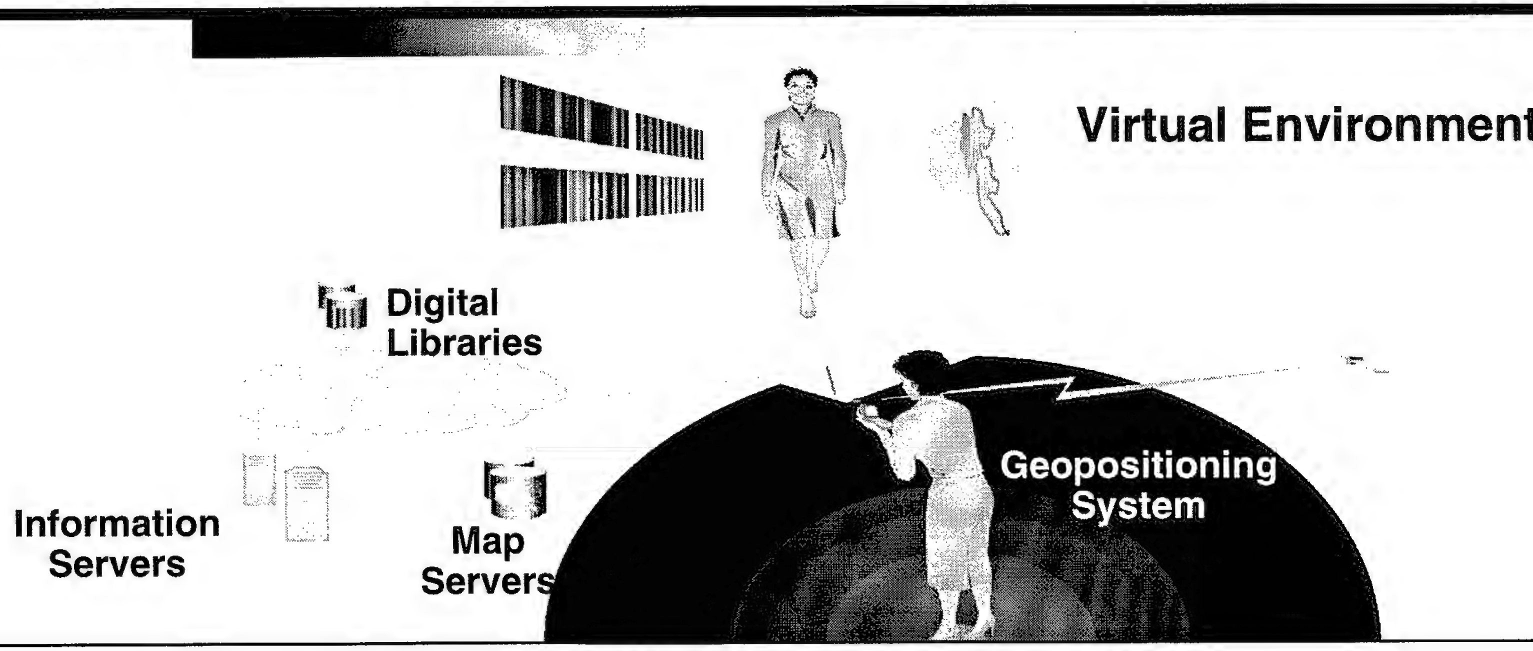
Distributed Environment Support

The grid establishes a distributed, networked environment of systems and users. Currently, DoD is striving to have a common operating environment for its C3 systems, but even if this were achieved, we will still have to cope with the heterogeneity of the commercial world and of our allies and potential coalition partners. To achieve our ends, the grid has to be conceived of within a context of significant heterogeneity. As such, it will have to be able to process information distributed around the world in many formats, in different languages, with different syntax, and in multiple types of presentations. We also need to be able to work with various organizations and people, and to cope with resultant language and cultural problems. An important objective is to facilitate a capability to present a consistent picture to all users based on the best information available from the massive, distributed, heterogeneous set of resources. We also need to provide distributed, virtual workspaces where collaborative processes can take place among users with vastly different types of interfaces and different abilities to connect into the workspace. The grid must provide information conditioning, mediation, interpretation, and presentation services to make this possible.

One of the greatest challenges is to make the massive, distributed, heterogeneous information an effective source of support to the warfighter. We need to provide important knowledge without inundating anyone with less important data. As the availability and richness of information increase, we need to contend with information overload as much or even more so than we do with scarcity of information. The grid will provide intelligent agents and smart information management and integration to help warfighters deal with this massive, distributed, heterogeneous environment.

Distributed Environment Support *(Continued)*

Limitations: Limited Ability To Integrate Processes Across Heterogeneous System Domains; Inadequate Knowledge Navigation and Retrieval for Massive, Distributed, Heterogeneous Systems; Minimal Capability for Exploiting Information Within the Network; Limited Ability to Manage Distributed Information; Limited Interoperability and Robustness for Disseminating and Integrating Information; Limited Robustness, Security, and Coverage in Common User Geolocation and Timing Services; and Limited Flexibility and Adaptability of Information Security for Coalition Operations.



Needed Technologies

Data Storage and Data Retrieval:
- Intelligent Agents for Knowledge Retrieval, Filtering, Integration, Sanitization, and Deconfliction
- Massive Data Storage and Management

Geolocation Support:
- Robust, Secure, Real-Time Geolocation, and Timing

Collaboration Support:
- Heterogeneous Multimedia Conferencing

Security:
- Multilevel, Adaptive Information Security

Automated Processes:
- Automated Language and Syntax Translation
- Automated Mediators and DBMS Tools
- Multimode, Multilingual Interface Services

Distributed Environment Support *(Continued)*

Limitations

The major problem areas related to distributed environments concern heterogeneity and potential massiveness of the total set of users and information resources.

Heterogeneity prevents users and systems from being able to ingest and digest information from diverse sources that may have important contributions to the command and control process. The heterogeneity can range from simple data encoding differences to more complex differences in syntax or presentation mode. Differences could be in the language among members of the coalition, in the mapping standards, and so forth. It could even include differences in the way the source and recipient choose to interface with the information; for example, text on one end and voice on the other. We also lack the ability to automatically integrate information from different domains, to establish integrated pictures rather than separate screens that the users have to "integrate in their heads." An example of this is the current limitation in presenting the decision maker with a map that shows the operational situation, the logistics and transportation situation, and the threat projections, all within a common display that allows a commander to judge the viability of the reception and onward movement of forces and support into the tactical battlespace.

Current systems offer access to a wide variety of information, but only if the users know where to look for it. As the number and variety of sources grow, the problem of information access overload will worsen. Somewhere buried in the thousands of e-mail messages or web sites will be the one nugget of information that is needed, but finding it will be nearly impossible. The richness of the information environment can easily be a negative factor that outweighs the advantages.

Consistency and ambiguity management across information domains are nearly nonexistent. Because most information systems stay within their own domains, this does not present a first-order problem; that is, it does not confuse the user of the information even if it may lead to problems with decision making that is not well synchronized across domains. If we allow users to have access to the full set of information across all domains, problems of ambiguity and inconsistency will become critical.

Finally, the problem of access control and information security is and will continue to be a "long pole in the tent" as we move to broader dissemination across operational and functional domains. We already see the problems with current INFOSEC and access control processes when we enter into coalition operations. Current capabilities are inadequate to allow the type of information sharing and distributed collaboration required in the operational concept.

Technologies

The technology discussed here fall largely into four areas that need significant emphasis.

The first is the need to be able to find and retrieve relevant information from the massive, distributed, heterogeneous environment. Ordinary web search tools will not be sufficient. We will need automated "intelligent agents," a form of distributed warfighter's associate to define the needed information based on the operational task or query and then to identify it wherever it exists in the heterogeneous environment. These agents will also have to be able to define and set triggers to track critical changes and bring them to the attention of end users.

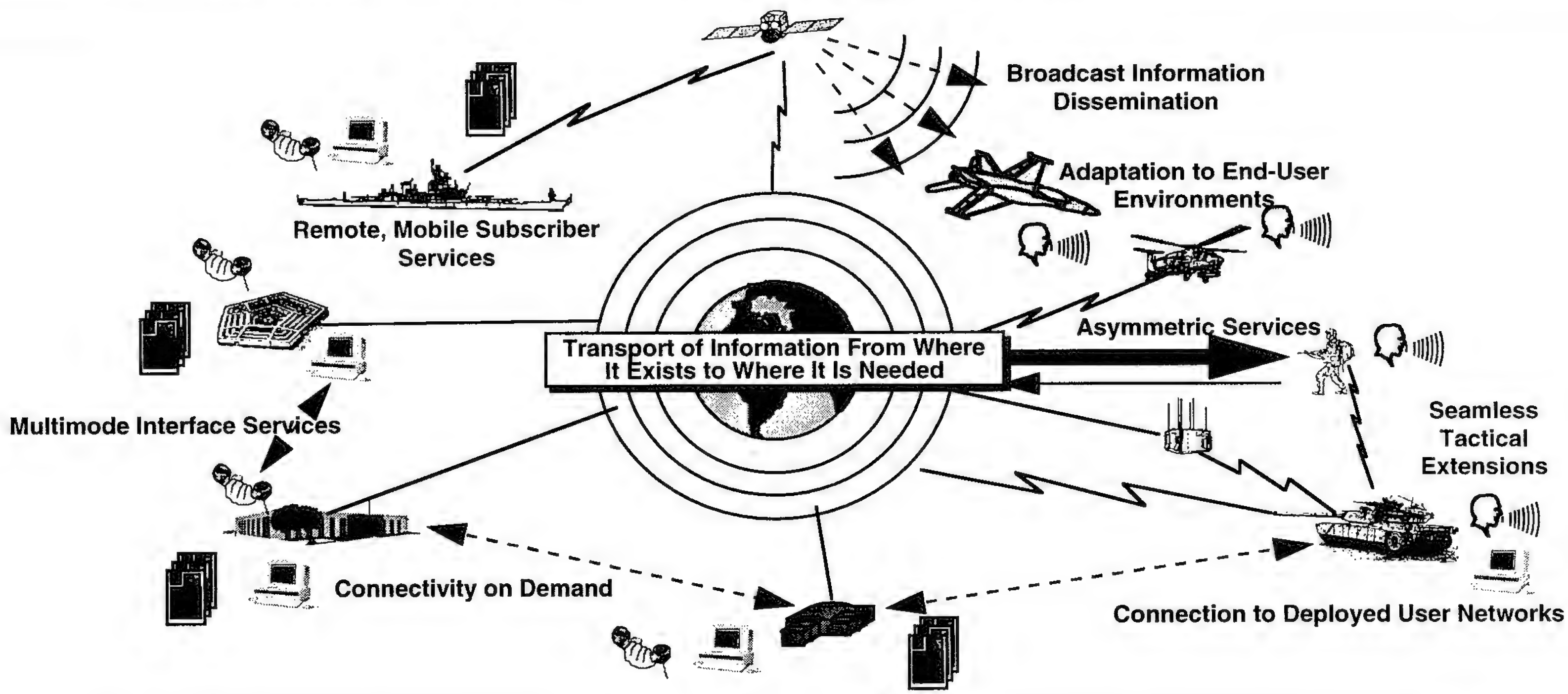
The second area is the need to mediate differences across the heterogeneous system. Technology is needed to provide rapid and accurate language translation and information interpretation in terms of cultural contexts. For example, in some cultures, a nod of the head may imply agreement, whereas in others it simply implies understanding. Smart agents will be needed to do the mediation for differences in data models, syntax, and implied meaning. We will also need automated means to integrate information that is provided in different modes, such as voice, text, and graphics.

The third is support to precise geolocation and timing that is secure in the face of both the natural environment and intentional interference.

Finally, we need substantial improvements in the ability to manage security and access control for information, both at the individual information element and aggregate levels. A simple example is a text file with individual paragraph markings. The file has to be disseminated to users with varying levels of access privileges, with each paragraph being included or deleted accordingly. We need advanced technology to allow all databases and other repositories of information to provide similar multilevel access management in accordance with a security model that may vary dynamically as the situation changes. Based on projected cycle times for battle management and sensor-to-shooter functions, we can estimate that access control may have to be responsive to location-independent access authentication within 1 minute and reconfiguration of the access privileges within several minutes.

Universal Transaction Services

Goal: Provide Warfighters and Their Systems With the Ability To Exchange and Understand Information, Unimpeded by Differences in Connectivity, Processing, Language, or Interface Characteristics.



Critical Functional Capabilities

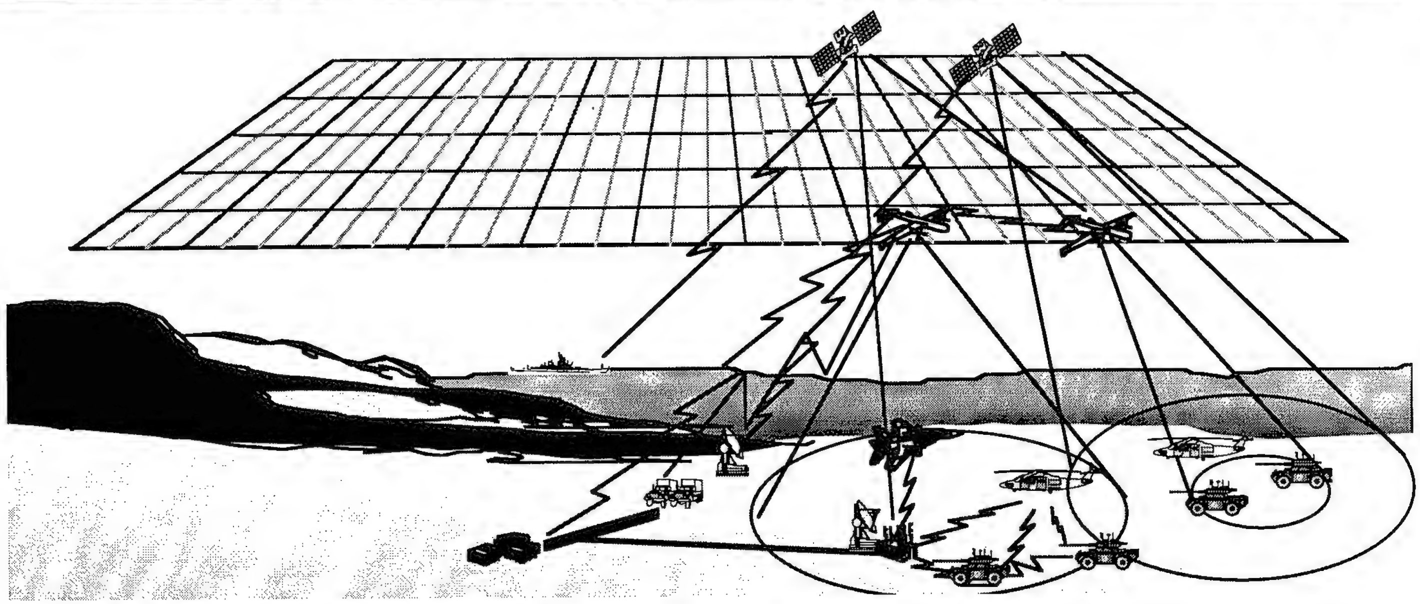
- High-Rate Broadcast
- Seamless Connectivity
- Automatic, Adaptive Information Conditioning
- Location-Independent Personal and Group Addressing
- Flexible, Adaptive Access Control

Universal Transaction Services

Transactions are the mechanisms by which warfighters will receive and exchange information. This implies the ability to transmit, receive, and interpret information from another person or system. Often we think of communications as the only element of the transaction, but the packaging and interpretation of the information are just as important. As we increasingly move toward digital and automated processes, the communication part of the problem is becoming eclipsed by the packaging and interpretation parts. Universal transaction support means that we will be able to move information from wherever it exists, in whatever form it exists, to wherever it is needed, and in whatever form it is needed. The goal is a universal transaction mechanism that is independent of the particular links or networks and that can serve any set of users, not just the limited set for which a particular link or network may be designed. The universal mechanism, whether it is ATM cells or something else, should be able to move from link to link and from network to network without requiring translation, conversion, or any other form of processing other than the modulation and signaling native to the particular links or networks. In the midterm, current proliferated data link standards and protocols must be reduced to a few, and in the longer term, the information packages and transaction mechanisms will be further reduced to achieve the end objective of a common, end-to-end, universal mechanism.

Universal Transaction Services *(Continued)*

Limitations: Information Transport Generally Tied to C2 Hierarchy; Lack of Interoperability; Unacceptable Limitations on Connectivity to Tactical User; Lack of Adaptive Conditioning of Information To Optimize Services; Users Burdened With Requirement To Know Network Addresses; and Limited Ability To Support Multilevel Security, Especially in Coalition Operations.



Needed Technologies

Communications:
- Rapidly Deployable Tactical Fiber Extensions
- Self-Adapting Tactical/Mobile Networking
- Tactically Extensible, High Rate, and Asymmetric Mobile Communications

Interoperability:
- Universal Information Transaction Mechanisms
- Automated Language, Syntax, Protocol Translation

Security:
- Adaptive, Multilevel Security Devices

Algorithms:
- Advanced Compression, Coding, Abstraction for Information Conditioning

Universal Transaction Services *(Continued)*

Limitations

Today's proliferated stovepiped systems and communications create many of the limitations we face in the near term. These systems were developed to support narrow functions for relatively small segments of the battlespace. Information exchange is supported to immediate superiors and to those that are tasked, but lateral exchange is generally not supported. Attempts to create lateral exchange are met by interoperability problems at nearly every level, from physical through transport to application. Of all these problems, the limitations are most significant at the tactical user levels, where if connectivity exists at all, it is extremely narrowband and range limited.

Wideband communications are becoming increasingly available, but integrating the new capabilities effectively to establish versatile end-to-end services remains a major limitation. Adaptive conditioning of the information to meet both the user's needs and the constraints of the networks will be an important element in establishing end-to-end integration across dissimilar links extending from the wideband infrastructure to the "last mile" tactical links.

The battlespace is dynamic, but the present systems usually rely on the sender's knowledge of the recipient's location and network address. This reliance will be inappropriate for supporting dynamic, often ad hoc, connectivities among members of tactical task teams that may be established to meet current sensor-shooter-commander needs rather than predefined organizational constructs. In addition to user-friendly addressing, the dynamic battlespace will demand a high degree of interoperability among heterogeneous networks and end users. Presently, we cannot mediate the differences in interface characteristics and presentation, including language, syntax, and mode of interfacing. In addition, we cannot provide mechanisms to ensure that access to information is managed in accordance with security and access privilege rules, while not restricting allowed accesses to information.

Technologies

A number of key technologies are needed to ensure universal transaction services. The development of standards and protocols that can accommodate the various types of transactions within a single common protocol suite is an important enabler. The current DoD and commercial experiments with ATM represent a start toward developing a transport mechanism that could be sufficiently universal, but much more work is needed to fully support the type of universal transaction mechanism that will be needed to make the grid truly supportive of the dynamic joint and coalition operations envisioned here.

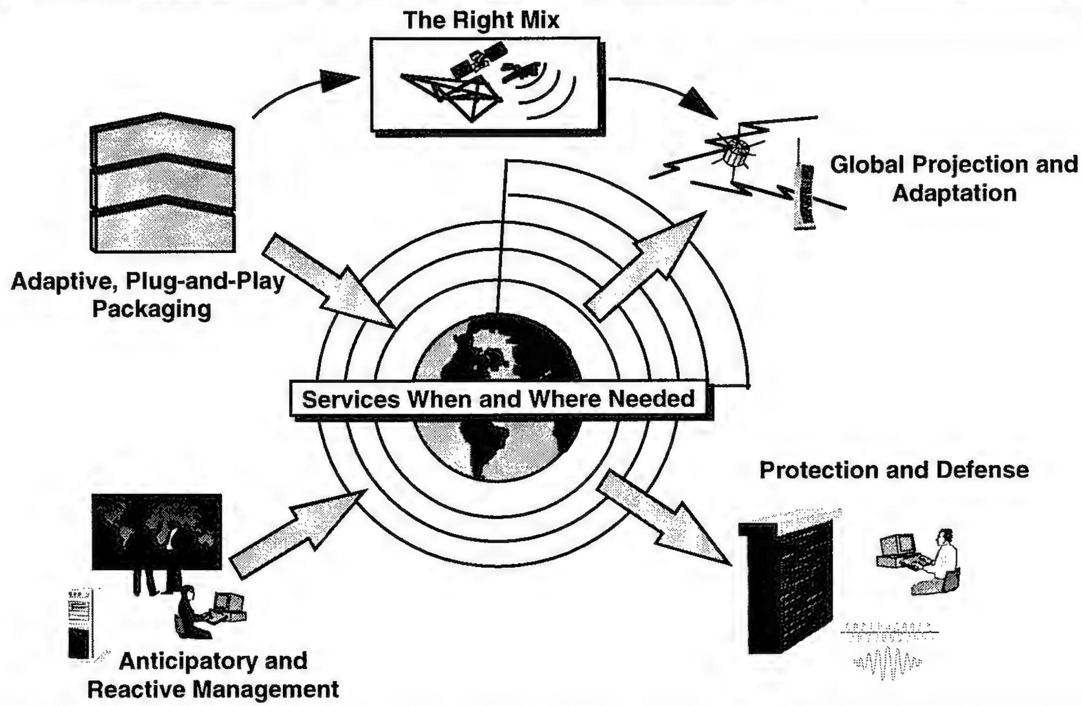
Automatic adaptation of information, as noted above, will be an important enabler of networks that can serve the heterogeneous set of users through a widely heterogeneous set of links and circuits. The network will have to "know" the constraints and user preferences as well as the content of the transport packages so that appropriate compression, coding, or abstraction can be accomplished.

Service to tactical users will be a demanding requirement. The tactical network topologies and environments will be very dynamic and often stressful in terms of throughput demands and link capabilities. Automatic means to optimize and restructure those networks will be needed. A combination of wideband, narrowband, and asymmetric services will need to be integrated to form a robust integrated network service for users on the move or at the end of the "last mile."

Finally, information security and access control technologies will have to support very complex and dynamic operational situations. We can expect operations to involve not only U.S. forces but also allies. Consequently, technology will need to allow flexibility to share and protect information, which implies capabilities far beyond multilevel security. It implies an ability to control access to information at the information element level, rather than only at the message, database, or system level. It also implies control of aggregate information according to a security model yet to be developed.

Assurance of Services

Goal: Provide High-Quality Services That the Warfighters Can Rely on To Be Available Whenever and Wherever Needed; That Can Be Adapted, Scaled, and Projected To Meet Dynamically Changing Demands and Service Capacities; and That Can Be Defended Against Physical and Information Warfare Threats.



Critical Functional Capabilities

- Service Extension
- Grid System Management
- Defensive IW and Information Protection

Assurance of Services

Users must be confident that the services and information provided by the grid will be available when needed and will be of sufficient quality and integrity to support them. Assurance of service must be commensurate with the warfighter's expectations and needs for those services. Clearly, 100 percent availability and reliability cannot be ensured, but we do need to ensure a level of service high enough to avoid imposing a weak link in the C4I chain supporting the deployed forces. This assurance is twofold: confidence in availability of services, and in the integrity and fidelity of the information.

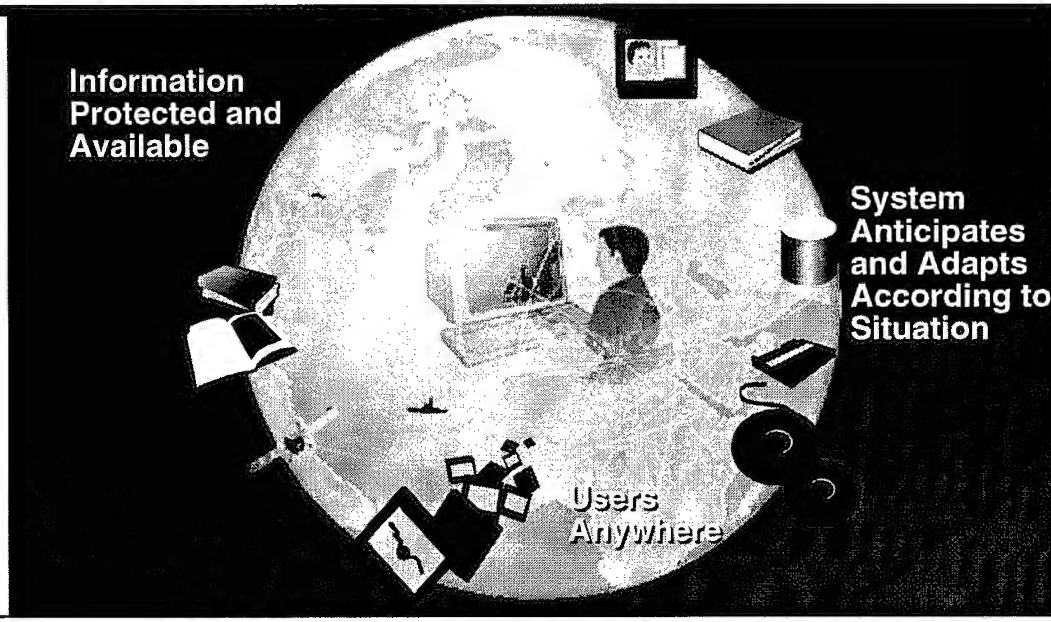
The first requirement is provided by a combination of robust architecture, responsive network management, defenses against physical and information warfare threats, and restoration capabilities. Grid management and defenses must be integrated within an overall management and control system that provides sufficient confidence for users to be willing to give up their organic systems in favor of a more capable grid.

The second requirement is for information quality and integrity. It also demands comprehensive system management and defense. In addition, we need to provide agile, adaptable access to information, tailored to user access privileges, including security classification. The grid must ensure protection of information from unauthorized access, while also preventing unauthorized intrusions or changes to shared information.

One of the greatest challenges will be to provide features and services that users will trust.

Assurance of Services *(Continued)*

Limitations: Lack of Plug-and-Play To Allow Adaptation of Services and To Project Information-Intensive Support Globally; Lack of Confidence That Nonorganic Assets Will Be There When Needed; Lack of Predictive/Anticipatory Network Management Capabilities; Lack of IW Sensors and Processors for Grid Self-Defense; Limited Ability for Supporting Multilevel Security; and Limited Ability To Provide Both Capability and "Hardness" in Commercially Derived Services.



Needed Technologies

Information Warfare
- IW Surveillance and Defense Tools

Models and Simulations
- Tools for Projecting and Visualizing Grid Capabilities in Terms of Operational Needs

Interoperability
- Low-Cost Techniques for Appending Robust Front Ends and "Shells" to Commercially Derived Systems

Automated Processes
- Anticipatory Services Management Tools

Security
- Multilevel, Adaptive Information Security

Assurance of Service *(Continued)*

Limitations

Grid services must be easy to access, provide significant information and services, and be robust in wartime and peacetime. Otherwise, warfighters will not shift their dependence for information services from their own systems to the shared grid. Present capabilities fall far short of providing the required level of confidence.

The current architecture is rigid and nonresponsive, having evolved piecemeal rather than having been planned. The individual elements were built to meet specific needs without a recognition of the potential for tremendous improvement if the elements could integrate. Present capabilities cannot adequately use the available resources to provide the most effective allocation and do not degrade based on mission priorities. Present systems are incapable of projecting information globally or suddenly providing significant communications capability to supplement or replace existing communications. Individual groups presently maintain separate capabilities to ensure a basic level of service that is organic.

Today's network management services are simplistic. They do not anticipate where service needs to be supplemented and provide it. Commercial networks work this way but we cannot yet deal with an environment that changes based on the situation, rather than the day of the week or an anticipated holiday. The present capability to prioritize service allocation is unresponsive to changes in the mission or overall situation.

At present, an ability to sense intrusion, detect it, and respond to it is being developed, to some extent, in the commercial environment; but it will require significant extension to support the warfighter's environment and security needs. Sensors, IW models, IW fusion techniques, and IW damage assesment are all examples of some first-order capabilities that are lacking.

Multilevel security limitations have been a concern for many years. These problems hamper the distribution of critical information and effectively block the efficient use of communications bandwidth. This limitation is especially severe when working with coalition forces. Beyond the present system limitations is the need for information security that addresses security issues at the information element level rather than at the product level.

Commercially derived services have been a boon to the warfighter, but these services are not developed and hardened for the environment. Dependence on current commercial products will be a significant limitation unless a means is found to add robustness.

Technologies

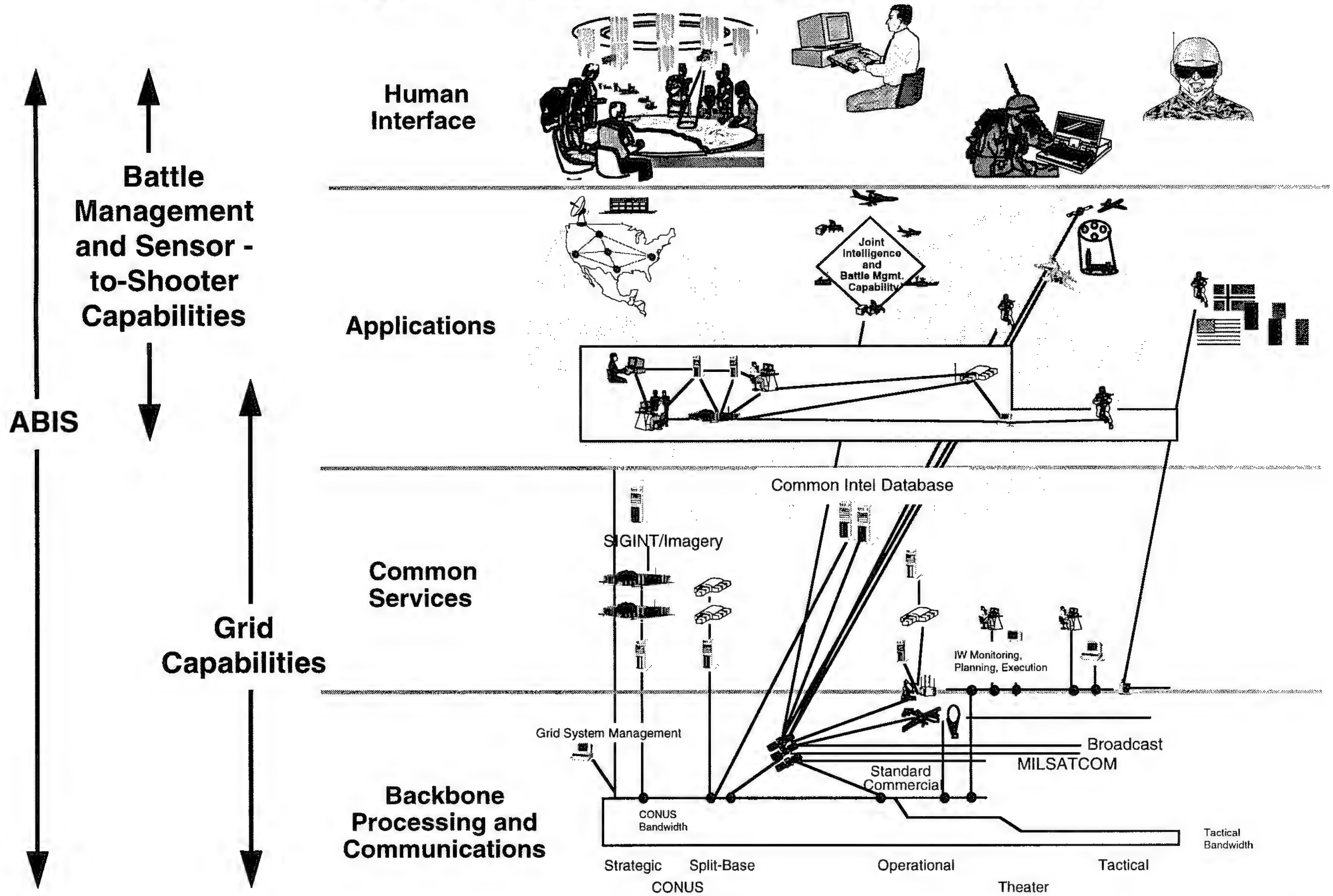
Defensive IW protection and response measures are needed to defend against the so called "hackers" threat, and for the more serious "terrorist" threat against commercial infrastructure and services. These measures need to be integrated with the military-specific communications measures. Intelligent agents and other artificial intelligence techniques must support the detection of patterns and identify an attack. Near real-time, grid-wide detection, characterization, and response to IW attacks are needed and will require advances in M&S as well as machine reasoning. These capabilities must be integrated with grid management capabilities to provide responsive and effective control of the grid.

The grid must also be managed to allocate resources in accordance with operational and tactical plans. This requires an ability to foresee the communications and information management needs implied by the operational plans. It also requires that the grid resources be considered among all the other combat support resources as part of an integrated C2 process. Anticipatory system management (out to several "cycle times" for battle management and sensor to shooter cycles) requires "smart" network management and M&S to anticipate the likely courses of the battle and the communications requirements associated with them. Visualization of the operational implications of management decisions on all elements of the grid, from strategic and operational levels through tactical systems, will provide the tools needed to choose among options. Full, near real-time visualization of current and projected status of the grid across all domains will allow responsive reaction to problems as they arise.

Adaptive, multilevel security and access control will also be needed. This is particularly important for the distributed environment and coalition forces that the grid must support.

Shells to harden commercial products while maintaining their capabilities and interoperability would provide an increased ability to leverage the marketplace. These shells might encase a single device, such as a radio or computer, or they might add IW protection to a commercial network.

System Considerations
Layers of Opportunity and Challenge



System Considerations

This figure presents a system perspective, layered to depict the human interface, applications, common services, and backbone processing and communications functions.

The top layer is the interface to users. The human interface layer provides displays and controls needed for situation assessment, planning, sensor management, force management, and execution. These interfaces need to span users in environments that range from the cockpit and tank to the battle manager. One aspect of the system is the ability to provide information to the shooter during mission execution without distraction. The shooter's interest is narrow in focus and deep in detail. The shooter's interest contrasts with the planner's and battle manager's presentations, which need to allow a view that is broad in scope and occasionally deep in detail. The user interfaces for monitoring and maintaining the system will also need to mirror the sophistication of the system. These interfaces are needed to provide access to all other layers.

The second layer contains the applications residing in the C4I systems. The applications layer is composed of tailored capabilities needed for each node to perform its function. These are the capabilities that support the battle management and sensor-to-shooter function directly. These support development of the situation assessment, planning, force management, and execution function. The wide arrows indicate the flow of information from the application layer to the grid for repository and dissemination. Many applications provide machine intelligence and reasoning to support more rapid decision making with more information. This layer also provides the models and simulation accessed through the grid. Each node and application of the system must contribute to, and be responsive to, the IW monitoring and protection function in the services layer. Some of the applications may be useful to a variety of functions. There may need to be a migration path from the application layer to the services layer as an application is identified to be able to support many other operational nodes.

The service layer, which is the third and upper layer of the grid itself, is a set of common services. It provides necessary capabilities that are common to many applications or are needed at many application nodes. It also provides services necessary to make the grid more efficient or effective. The service and backbone processing and communications layers make up the grid. The transaction-oriented services in this layer make the system interoperable, efficient, and user friendly. Session-oriented services support collaboration and mission rehearsal, and need to be available to a wide variety of users from CONUS to the battlefield. Intelligent information retrieval and information repositories provide the common basis for consistent dominant battlefield awareness to all functions. Finally, IW protection is the monitoring, planning, and warning to decrease the risk of effective penetration. The layers above and below will contribute to this function.

Finally, the backbone processing and communications form the system foundation, which are the second and third level of grid capabilities, provide the ubiquitous communications that are a premise of the system concept. These communications include a variety of media, such as satellite communications, fiber optics, and RF, all functioning as an integrated system. This layer provides the processing assets needed for the services and it can provide very high-speed processors that are shared. The backbone provides sophisticated network management and physical protection of the network from information warfare.

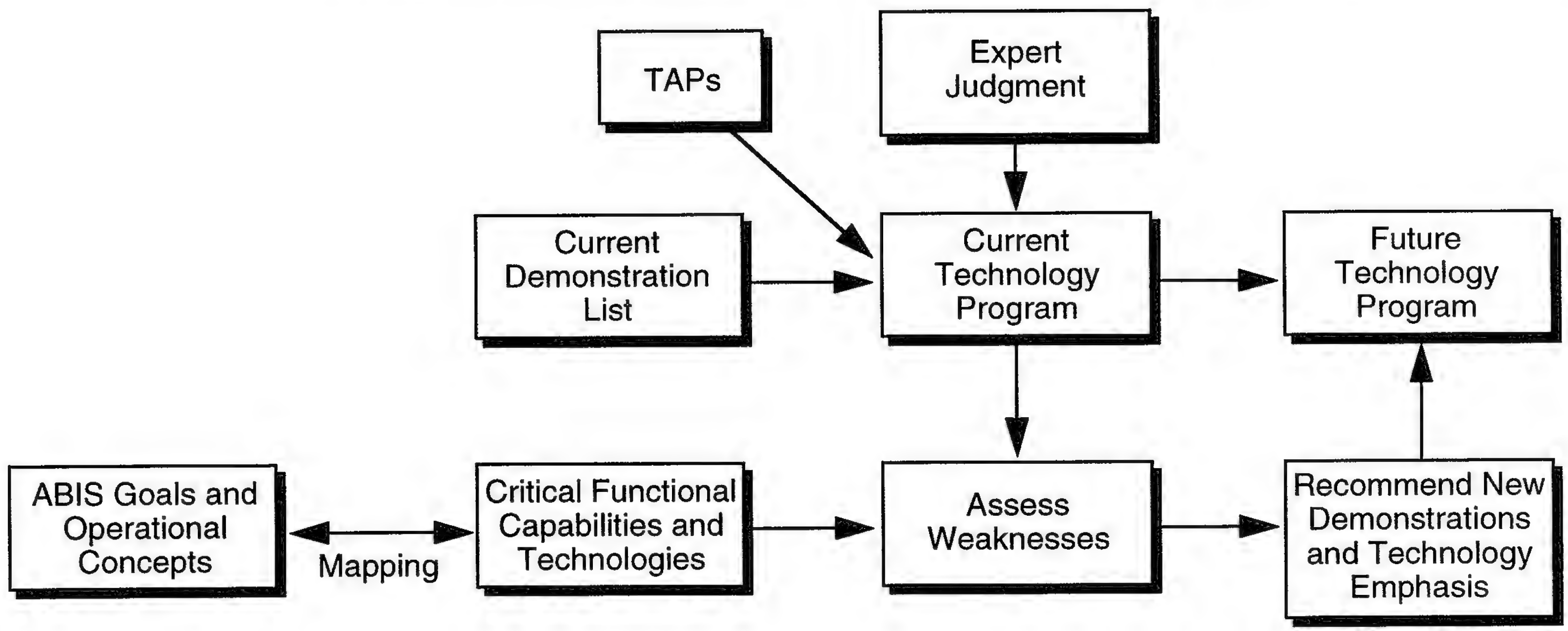
4. Needed Technology Initiatives

Needed Technology Initiatives

This section summarizes the assessment of the current technology program and identifies needed technology demonstrations and areas of focus.

Focusing the Technology Program

Goal: Provide a Basis for an Evolutionary Technology Program With the Appropriate Mix of Technology Base, and Technical and Operational Concept Demonstrations To Achieve ABIS Goals of Fully Supporting New Warfighting Concepts by 2010.



Focusing the Technology Program

The DoD's science and technology program is the foundation for achieving the ABIS vision. The current program was assessed by comparing the functional capabilities and technologies needed for the desired ABIS operational capabilities with the demonstrations and technologies associated with the current technology program. (Time did not permit a review of DoD research programs.) The assessment was based on readily available documentation describing the current programs. The documentation included the current list of ACTDs and ATDs,* the relevant subset of Technology Area Plans (TAP), and the expert judgment of members of the ABIS Task Force. A demonstration was considered current if it had been approved by December 1995. Drawing on the available data, a time-phased roadmap was developed to summarize technology initiatives that are needed for ABIS. (Volume VI contains a detailed description of the assessment methodology and results.)

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* The sources of information on these demonstrations:
  1. "Description of Approved Concept Technology Demonstrations," provided to the Task Force by ODDR&E (This list also included 27 Army ATDs, 19 Navy ATDs, and 4 Air Force ATDs.)
  2. "Advanced Concept Technology Demonstration Master Plan," April 1995
  3. Descriptions of 26 Air Force ATDs provided by Rome Laboratory
  4. Miscellaneous material provided by task force members.

Current Demonstrations Relevant to ABIS

- Precision Rapid Counter Multiple Rocket Launcher (MRL) ACTD
- Precision SIGINT Targeting ACTD
- Combat Identification ACTD
- Advanced Joint Planning ACTD
- Joint Logistics ACTD
- Synthetic Theater of War (STOW) '97 ACTD
- Distributed Air Operations Center (AOC) ATD (Air Force)
- Joint Forces Air Component Commander (JFACC) ATD (DARPA)
- Littoral Warfare Real-time Electromagnetic Interference Management System ATD (Navy)
- Battlespace Command and Control ATD (Army)
- Semiautomated Image Processing ACTD
- Battlefield Awareness and Data Dissemination ACTD
- Digital Battlefield Communications ATD (Army)
- Speakeasy ATD (Air Force)
- Joint Task Force (JTF) Network Control ATD (Air Force)
- Survivable ATM ATD (Air Force)

Current Demonstrations Relevant to ABIS

The information provided in the previous figure presents the titles of the current demonstrations determined relevant by the ABIS Task Force. A brief description of each demonstration area follows:

Precision Rapid Counter MRL ACTD: A significantly enhanced capability to neutralize a time-critical target set: large, long-range multiple rocket launchers (MRL) operating from dispersed, hardened shelters.

Precision SIGINT Targeting ACTD: Development and demonstration of a near real-time, precision targeting, sensor-to-shooter capability using existing signals intelligence data from national and tactical assets.

Combat ID ACTD: Provision of an integrated set of combat identification capabilities to support air-to-ground and ground-to-ground combat.

Advanced Joint Planning ACTD: Integration of emerging communications and planning technologies to achieve improvements in time and accuracy of planning for contingency response for USACOM and component staffs.

Joint Logistics ACTD: A capability for the CINCs and JTF Commanders to rapidly plan and execute more responsive and efficient logistics support to military operations.

Synthetic Theater of War (STOW) '97 ACTD: Combining virtual and constructive simulations and live exercises in an overall exercise mechanism that will allow forces to train in "a virtual state of war" without the restrictions and cost of a live exercise.

Distributed AOC ATD (Air Force): Demonstration of the applicability of distributed computing techniques and object-based designs to create a geographically deployable C3 system that provides all the required C3 functionality and improves its flexibility by permitting multiple locations to operate as a single C3 entity.

Joint Forces Air Component Commander (JFACC) ATD (ARPA): Use of continuous, concurrent, and collaborative planning and automated planning tools to speed up and integrate the air campaign planning process to hold high-value targets at risk.

Littoral Warfare Real-Time Electromagnetic Interference Management System ATD (Navy): Demonstration of an electromagnetic environment monitoring system for real-time control of combat system frequency assignments. Will provide assured spectrum availability for IW without degradation due to electromagnetic interference.

Battlespace C2 ATD (Army): Development, integration, and refinement of information and knowledge-base technologies and systems into a battlefield visualization capability with integrated decision support. Uses combat visualization and wargaming support tools to enhance decision/reaction/dissemination timelines.

Semiautomated Image Processing ACTD: Rapidly produce and field a capability that will significantly improve an image analyst's ability to provide accurate, timely situation awareness to warfighters.

Battlefield Awareness and Data Dissemination ACTD: Provision of a consistent view of the battlefield by disseminating operational, intelligence, and logistics information widely and inexpensively using direct digital broadcast satellite (DBS) technology.

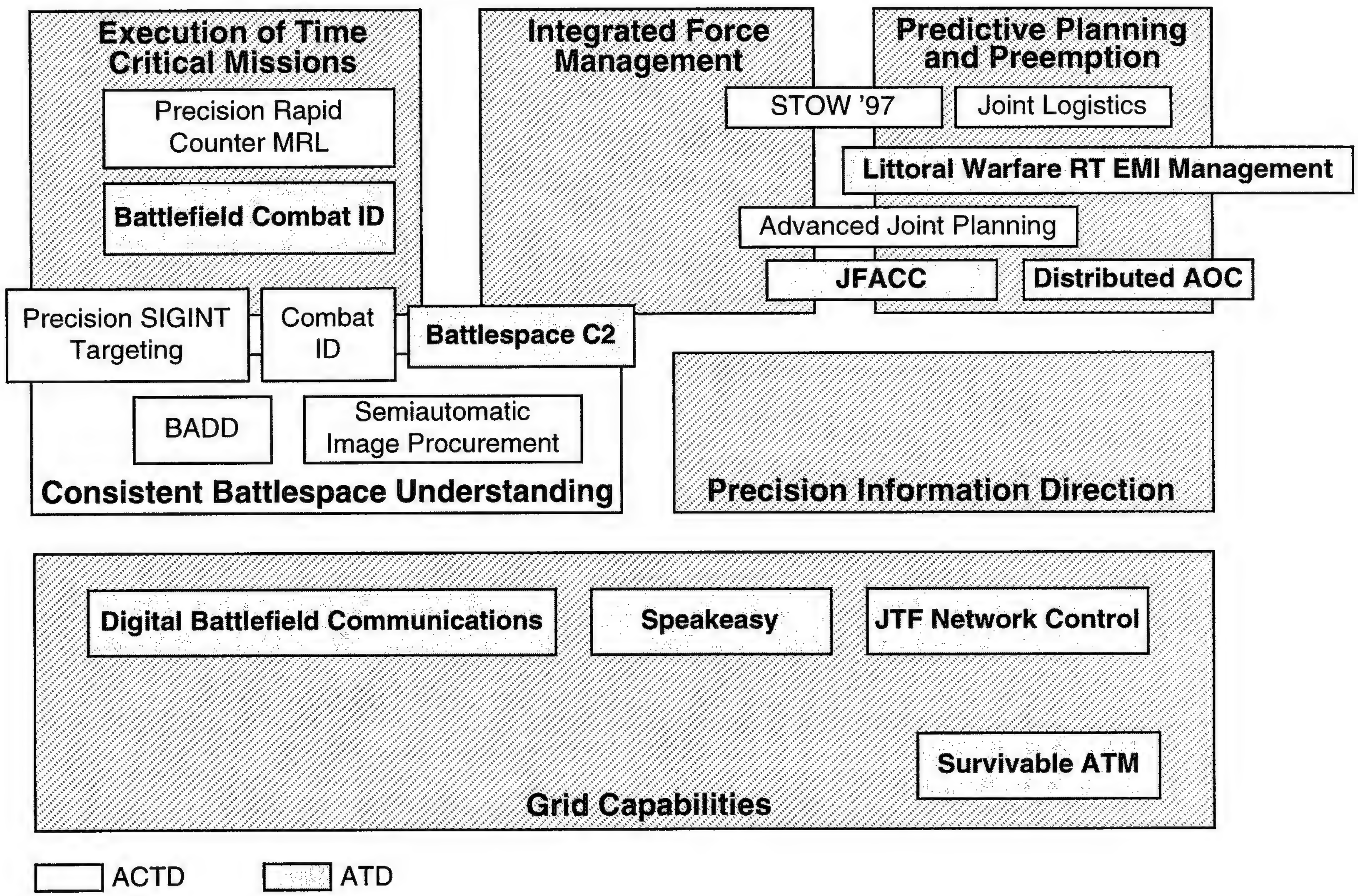
Digital Battlefield Communications ATD (Army): Demonstration of a secure, robust, seamless, digital, multimedia information transport capability that is compliant with and exploits emerging commercial standards and the DISN architecture.

Speakeasy ATD (Air Force): Demonstration of achievable reliable radio communications connectivities on the battlefield by using a programmable radio supporting multiple bands, waveforms, channels, functions, and platforms. It will have an open, modular architecture with a library of common modules across various platforms and radio suites.

JTF Network Control ATD (Air Force): Demonstration of the ability to monitor and manage communications assets across dissimilar network topologies and maintain interoperability with the various protocol stacks that will compose the overall deployed JTF.

Survivable ATM ATD (Air Force): Design, develop, and implement within commercial and government platforms, and demonstrate and deliver a set of previously unavailable capabilities to achieve and maintain reliable performance of commercial asynchronous transfer mode (ATM) technology in military theaters of operations.

Relationship of Current Demonstrations to Operational Capabilities



Relationship of Current Demonstrations to Operational Capabilities

This figure illustrates the applicability of each of the demonstrations to the operational capabilities identified previously for ABIS. Only the demonstrations that were deemed fully relevant are shown here.

Contribution of Current Program to Operational Capabilities

	Operational Capabilities	Contribution of Current Program	Relevant Efforts		Weaknesses of Current Program
Effective Employment	Predictive Planning and Preemption		• Advanced Joint Planning ACTD • Joint Logistics ACTD • USTRANSCOM Planning ATD	• Total Distribution ATD • Distributed AOC ATD • JFACC ATD	• Planning is sequential, nondistributed • No coordinated IW Battle Management • Limited M&S for C4I & Spectrum Dominance Planning • M&S too slow for COA Analysis • Systems are nondistributed, large footprint, slow to deploy
	Integrated Force Management		• Counter Proliferation ACTD • STOW '97 ACTD • JFACC ATD		• Tasking of force elements is sequential, not simultaneous • Limited common presentation of situation & campaign objectives • Inability to apply complex ROEs
	Execution of Time-Critical Missions		• Precision Rapid Counter MRL ACTD • Cruise Missile Defense ACTD • Precision SIGINT Targeting ACTD • Combat ID ACTD • SIGINT Correlation ATD • Battlefield Combat ID ATD		• Insufficient speed & accuracy of target location and tracking • Inadequate & slow situation assessment in target area • Information dissemination to C2 & shooters is sequential
Battlespace Awareness	Consistent Battlespace Understanding		• BADD ACTD • Combat ID ACTD • Semi-Automated Image Processing ACTD	• Battlespace C2 ATD • SIGINT Correlation ATD • Rapid Battlespace • Visualization ATD	• No common operational picture • Search for relevant information manually intensive • Limited ability to monitor & predict enemy cycles • Limited capability to project friendly/enemy situation
	Precision Information Direction		None		• No capability to optimize efficiency in use of C4ISR assets • Limited coverage of high value enemy operational cycles
Grid	Distributed Environment Support		• Joint Logistics ACTD • Distributed AOC ATD • Hypermedia Integration ATD • COMPASS		• Limited, manually intensive processes for information retrieval across heterogeneous, distributed systems • Limited support for distributed virtual workspace across heterogeneous and asymmetric networks
	Universal Transaction Services		• Speakeasy ATD • Digital Battlefield Communications ATD		• Information transport tied to C2 hierarchy, limiting flexibility of connectivity • Limited interoperability for heterogeneous systems • Limited connectivity to on-the-move elements
	Assurance of Services		• Survivable ATM ATD • JTF Network Control ATD • Joint Communications Planning and Management System (JCPMS)		• Limited capability of the C4I infrastructure to respond to users' changing needs • Limited capability to monitor and respond to IW attacks • Limited capability for responsive extension to and within theater

Contribution of Current Program to Operational Capabilities

This figure illustrates the contribution of the current program to the needed operational capabilities. The results can be visualized by the degree to which a glass is full. For example, a full or nearly full glass indicates that if the objectives of the S&T programs are met, the ABIS capability objective will essentially be addressed. An empty glass indicates little or no emphasis on the critical areas. Partly full glasses indicate qualitative judgments that the capabilities are being addressed to some degree. This is a judgmental factor that is a result of having reviewed the extent to which the needed capabilities are addressed by the various demonstrations. The next two columns depict elements of the current program that are supportive and the remaining weaknesses that need to be addressed.

There is considerable ongoing activity within the current programs that supports Execution of Time-Critical Missions, Predictive Planning and Preemption, and Consistent Battlespace Understanding; even so, the program has the weaknesses shown in the right-hand column that could be usefully addressed by additional effort.

There is a lesser level of activity in support of Integrated Force Management and the three Grid capabilities and essentially no activity relative to Precision Information Direction. Although some of the functions required by Precision Information Direction (such as theater intelligence processing for broadcast) are being individually addressed, there has been no effort to demonstrate a partial or integrated capability for this operational capability.

In conclusion, many current efforts have relevance but significantly more ABIS-focused activity is needed.

Opportunity Areas for New Demonstrations

Key Critical Areas That Can Be Advanced in the Near-Term:		New Demonstration Opportunities:
• Integration of Multiple Sensor Information To Improve Target Acquisition and Tracking Performance	→	Integrated Fusion and Target Tracking Automated Target Recognition
• Automated Weapon-to-Target Pairing	→	Automated Weapon-to-Target Pairing
• Command and Control of Forces in the Early Stages of a Campaign	→	Joint, Early Entry C4I for Rapid Force Projection
• Planning and Execution of an Information War in Concert with Conventional War	→	Information Warfare Battle Management
• Dynamic Management of C4ISR Assets To Support the Objectives of the Warfighter	→	Integrated Sensor Tasking
• Quality and Speed of Visualization of the Combat Situation for the Warfighter	→	Real-Time, Cognition-Aiding Displays
• Seamless Networking of Users Across Diverse Heterogeneous Systems	→	Robust Tactical/Mobile Networking
• Dealing With Ambiguous and Heterogeneous Information	→	Distributed Situation Assessment
• Management of the C4I Infrastructure To Best Meet the Warfighters' Needs	→	C4I for the Grid
• Automated Secure Network Interfaces	→	Information Security

Opportunity Areas for New Demonstrations

An integrated group of participants from the Secretariat and the working groups (the Integration Team) investigated the weaknesses of the current program as addressed in the preceding figure. A set of 10 key areas that could be advanced with near-term technology has been identified. These, in turn, lead to a corresponding set of 11 opportunities for new demonstrations. Criteria for developing these are that the technology, in each case, is mature enough to allow a near-term demonstration of at least an operationally useful partial capability. Key critical areas and the corresponding demonstration opportunities are shown in this figure and should be pursued as soon as possible.

Proposed ABIS Demonstration Areas

- Integrated Fusion and Target Tracking
- Automated Target Recognition
- Automated Weapon-to-Target Pairing
- Joint, Early Entry C4I for Rapid Force Projection
- Information Warfare Battle Management
- Integrated Sensor Tasking
- Real-time, Cognition-Aiding Displays
- Robust Tactical/Mobile Networking
- Distributed Situation Assessment
- C4I for the Grid
- Information Security

Proposed ABIS Demonstration Areas

The preceding figure lists each proposed demonstration area. A summary description of each proposed area is provided below and these are described in more detail in Annex B of Volume VI, Mapping of Operational Capabilities, Critical Functions, and Technology Initiatives.

Integrated Fusion and Target Tracking: Demonstrate continuous tracking of fleeting targets across multiple target operational cycles.

Automated Target Recognition: Demonstrate automated and/or semiautomated classification of a limited set of high-value, fleeting targets, target convoys, and their supporting infrastructure and technologies that include correlation of signatures across various sensor types.

Automated Weapon-to-Target Pairing: Demonstrate automated optimized pairing of weapons systems against specific targets from a high-value fleeting target set.

Joint, Early Entry C4I for Rapid Force Projection: Demonstrate an initial entry, small footprint C4I capability with distributed, collaborative planning and technology that includes collaborative virtual workspace, linked plans, and automated alarms.

Information Warfare Battle Management: Demonstrate an initial prototype IW surveillance network to provide monitoring and display of IW status of a set of computers and communications supporting a command node. It would also address IW planning, both defensive and offensive, and technologies that include a means of monitoring firewalls and guards, and display of status on an IW situation display, and rapid M&S to support IW COA analysis.

Integrated Sensor Tasking: Demonstrate integrated tasking of SIGINT and IMINT national and theater sensors to optimize collection for theater needs. Includes provision of near real-time sensor information directly to shooters for assigned targets.

Real-time, Cognition-aiding Displays: Demonstrate integration of information across services and mission areas to provide a comprehensive situational picture. Display tailoring tools to simplify the display for specific missions and interactive collaboration in a multisite environment.

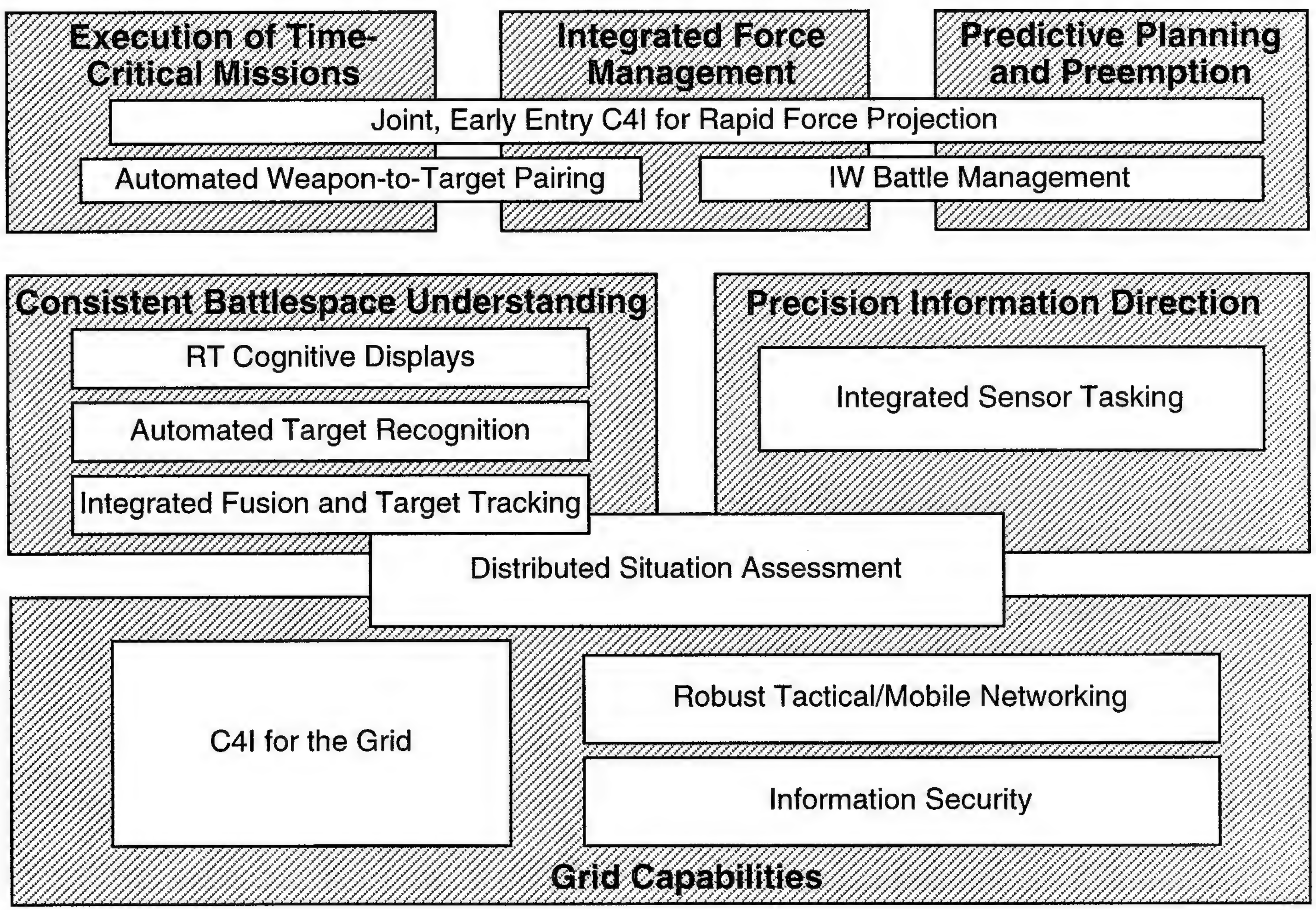
Robust Tactical/Mobile Networking: Demonstrate capability to rapidly configure tactical networks using available terrestrial, SATCOM, and relay capabilities, and provide transport conditioning and compression, and technologies that include programs such as Radiant Tin, progressive JPEG, and Out-of-Band orderwires.

Distributed Situation Assessment: Demonstrate the integration of technologies to process ambiguous information, create integrated knowledge from diverse domains; search and retrieve data from massive, distributed, heterogeneous databases; and assess current technology for cognitive displays. Serve as an adjunct to BADD ACTD.

C4I for the Grid: Demonstrate capability to exercise federated management of JTF and component networks using JCPMS and existing service systems and project network status onto the OPLAN. Demonstrate technology, including M&S to project OPLANs into the network loading and analysis systems for anticipatory management.

Information Security: Demonstrate the use of existing guards, gateways, and multilevel workstations to provide automated interfaces among U.S. and coalition forces, building on prior JWID demonstrations and technologies that include cell encryption gateways for extending ATM networking, and programs such as FASTLANE.

Relationship of Proposed Demonstration Areas to Operational Capabilities



Relationship of Proposed Demonstration Areas to Operational Capabilities

This figure depicts the applicability of the proposed demonstration areas to the needed operational capabilities identified earlier for ABIS. The proposed demonstration areas contribute to achieving all of the needed ABIS operational capabilities.

Contribution of Augmented Program to Operational Capabilities

	Operational Capabilities	Contribution of Current and Augmented Programs	How Proposed Demonstrations Contribute	Needs Beyond Augmented Program
Effective Employment	Predictive Planning & Preemption		• Joint, Early Entry C4I for Rapid Force Projection improves linking of plans, simulation, and intelligent triggers. • IW Battle Management demonstrates an initial IW planning capability.	• Automated nodal analysis • Fast running C4I/campaign M&S for COA and IW planning
	Integrated Force Management		• Real-time, Cognition-aiding Displays will improve understanding of commander's intent.	• Automated Joint Force ROEs Synchronization of forces
	Execution of Time-Critical Missions		• Integrated Fusion & Target Tracking and Automated Target Recognition support faster and more accurate targeting acquisition and location. • Automated Weapon-to-Target Pairing decreases the timeline for attacking and killing time critical targets.	• Rapid Situation Awareness in the local target area Mission to target pairing
Battlespace Awareness	Consistent Battlespace Understanding		• Integrated Fusion & Target Tracking and Automated Target Recognition support improved IPB. • Real-time, Cognition-aiding Displays support improved Situation Awareness and Understanding	• On-line collaborative access to smart MC&G • Fused, all-source picture with varying levels of aggregation • Situation projection for own and enemy COA estimation • Collaborative situation and BDA assessment • Common representation of battlespace understanding
	Precision Information Direction		• Integrated Sensor Tasking addresses maximizing the utility of all available sensor assets to the warfighter.	• End-to-end, task-synchronized, multimission support products to the warfighter
Grid	Distributed Environment Support		• Distributed Situation Assessment supports knowledge-based access, retrieval, and integration of heterogeneous information.	• Distributed, collaborative session support for heterogeneous users and interface modes • Virtual, collaborative workspace with heterogeneous users • Massive, heterogeneous, distributed information management
	Universal Transaction Services		• Robust Tactical/Mobile Networking supports rapid configuring of tactical networks, transport conditioning, and compression.	• More technology base effort is needed in Location Independent Addressing and Flexible, Adaptive Access Control.
	Assurance of Services		• Robust Tactical/Mobile Networking supports service extension. • C4I for the Grid supports federated network management and M&S for anticipatory management. • Information Security Supports information protection	• Automatic integration of information across systems and networks of varying levels of classification including US and coalition. • Control of access to information at information element, individual user, and model-based aggregate levels.

Augmented

Current

Contribution of Augmented Program to Operational Capabilities

This figure shows the improved support provided by an augmented demonstration program. In addition, for each capability it indicates how coverage would be improved and what would still be left to be done. The main reason that these latter technology areas, addressed in the right-hand column, cannot be addressed by demonstrations in the near term is that the technology is not sufficiently mature. This shortfall is the basis for recommendations of technology areas that need to be emphasized in the near-term technology base, which then lead to opportunity areas for demonstration in the longer term.

Areas for Future Demonstrations

- Distributed Empowerment
- Intelligent, Joint Force Automated Rules of Engagement (ROE)
- Retasking and Rehearsal of Coordinated Operations Enroute and On-the-Move
- Distributed Battlespace Opportunity Planning
- Joint Information Warfare and Spectrum Dominance
- Management of Dynamic Force Configurations
- Adaptive Force Package Tailoring
- Knowledge-Based Information Presentation
- Cognitive Mission Support to the Warfighter
- End-to-End Task Synchronized Mission Support Products to Warfighter
- Distributed Access to Consistent Information
- Retrieval and Integration of Heterogeneous Information
- Predictive Management of the Grid
- Integrated Defense and Management of the Grid

Areas for Future Demonstrations

The working groups, in particular the Battle Management Working Group, defined a number of demonstration areas for the development of future demonstrations needed to achieve the desired future ABIS capabilities. Work needs to be done to advance the technology areas listed in the figure before these demonstrations can be developed. These areas are listed and briefly described below. These demonstrations must be further defined and carried out in the 2000-2005 time frame. These demonstrations and their potential technologies have the potential of "filling the glasses" from the levels indicated in the figure "Contribution of Augmented Program to Operational Capabilities" to completely full. (These demonstrations are discussed more fully in Annex B.)

Distributed Empowerment: "Intuitive" command based on shared information understanding in lieu of hierarchical command orders.

Intelligent, Joint Force Automated Rules of Engagement (ROE): Distributed, cooperative ROEs intelligent enough to provide "legal"-quality cues on evasive and deceptive tracks and over-the-horizon engagement coordination.

Retasking and Rehearsal of Coordinated Operations Enroute and On-the-Move: Dissemination to enroute units of coordinated task changes, and conduct of coordinated multimission, multiechelon rehearsal of coordinated operations and simultaneous engagements.

Distributed Battlespace Opportunity Planning: Look-ahead precision attrition and countermove planning tied to a central strategy.

Joint Information Warfare and Spectrum Dominance: Dynamic control of the offensive and defensive information and frequency battlespace along with continuous battlespace projection and understanding in the presence of uncertainty.

Management of Dynamic Force Configurations: Robust planning and assessment by dynamically changing teams on-the-move.

Adaptive Force Package Tailoring: High-resolution, tactical joint force package tailoring and reduction of force movement and supply backlog during dynamic reconstitution and redeployment.

Knowledge-Based Information Presentation: Continuous battlespace projection and understanding in the presence of uncertainty

Cognitive Mission Support to the Warfighter: Adaptive situation/deception understanding tailored to dynamic course of action (COA) and task assessment.

End-to-End Task Synchronized Mission Support Products to Warfighter: Integrated, responsive coordination of tactical and supporting nonorganic sensors by the tactical commander, with "just-in-time" delivery of processed mission support products.

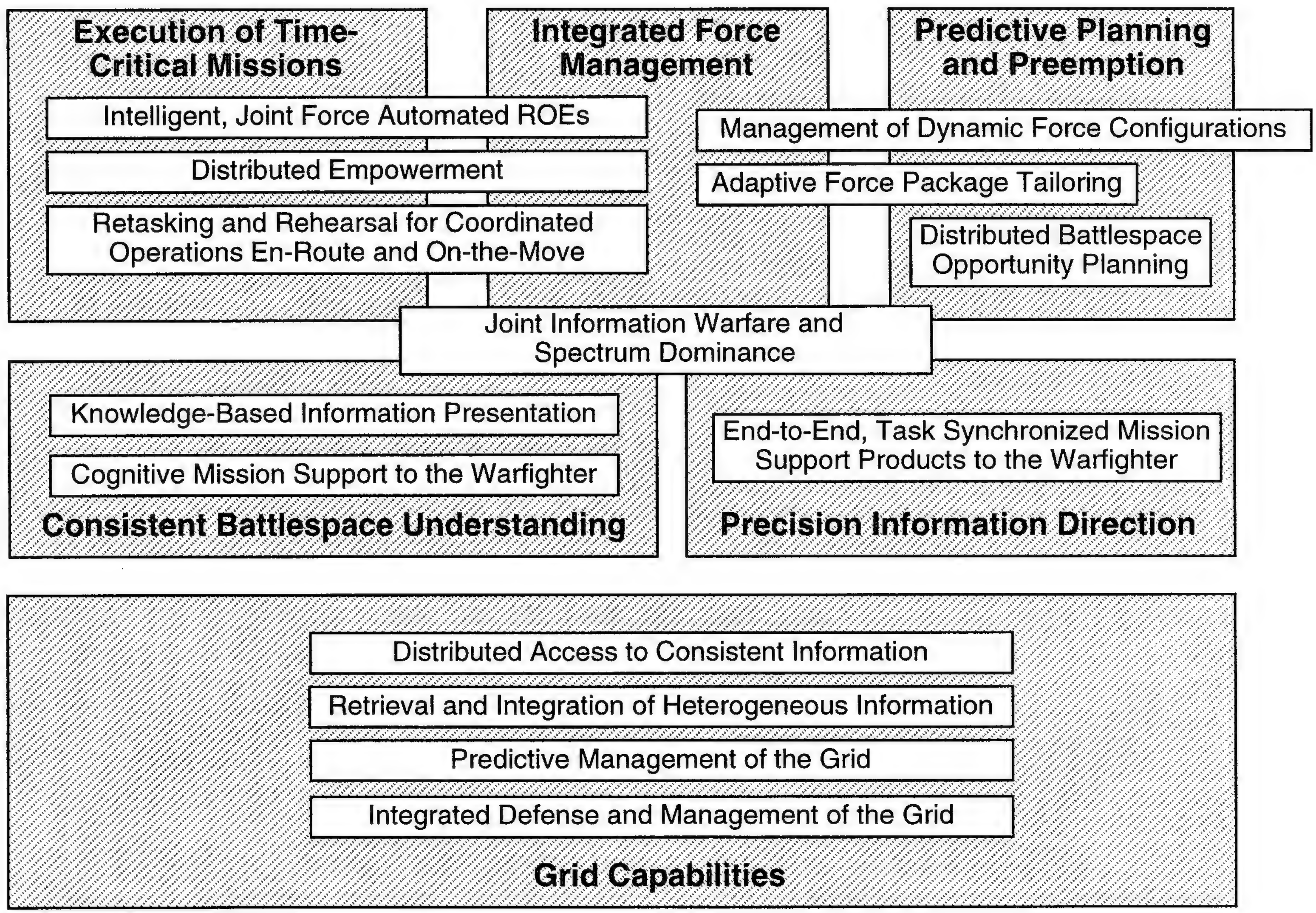
Distributed Access to Consistent Information: "Virtual staffs" and intelligent agents providing all available knowledge.

Retrieval and Integration of Heterogeneous Information: Completely seamless networking, unimpeded by heterogeneity.

Predictive Management of the Grid: Anticipate and adapt network and service, using models and simulations to predict operational needs.

Integrated Defense and Mangement of the Grid: Dynamic tactical extensions provided with high confidence, and IW surveillance and defense tools integrated with grid management.

Relationship of Future Demonstration Areas to Operational Capabilities



Relationship of Future Demonstration Areas to Operational Capabilities

This figure depicts the applicability of the proposed future demonstration areas to the needed operational capabilities identified earlier for ABIS. As mentioned previously, success in all these demonstrations would result in "filling the glasses" for all operational capabilities.

Technology Areas Receiving Emphasis In the Current Demonstration Programs

Measured by Level of Activity in Demonstrations

Moderate to High Activity

- Joint, Multisensor and Information Fusion, Sensor Cross-Cueing, and Tracking Algorithms
- Automatic Target and Infrastructure ID, Recognition, Behavior and Change Detection and BDA
- Distributed, Collaborative, Continuous Dynamic Automated Planning and Scheduling
- Fault Tolerant M&S for Mission Preview, Rehearsal, and Training
- Cognitive Displays, Virtual Reality, and 4D Real-Time Presentation
- High Rate Broadcast

Some Activity

- Intelligent, Distributed, Object-Oriented Maps
- Tactically Extensible High-Rate and Asymmetric Mobile Communications
- Distributed, Collaborative, Virtual Workspaces
- Virtual Anchor Desk

Technology Areas Receiving Emphasis In the Current Demonstration Programs

The working groups identified needed technologies required to support ABIS functions and achieve ABIS warfighting concepts. These were consolidated into a list of 43 technology needs that are listed in Volume VI, Annex B. Annex B also provides analysis of the level of support for these technology needs in the current demonstration program. It was found that 10 of these technologies have ongoing activity and they are indicated in the figure. These activities should be maintained and, as appropriate, supplemented.

Technology Areas Needing Emphasis in the Technology Base
Measured by Level of Activity in Demonstrations

Little or No Activity

Intelligence Processing
- Automated Data Validation and Data Validity Tags
- Image Understanding and Pattern Recognition
- Automated IPB Processes

Automated Planning and Force Management Tools
- Automated Nodal Analysis and Weaponeering
- Automated Target/Weapon Pairing and Update

Fast Running M&S for COA/C4ISR Analysis
- Rapid M&S, Including C3I, for Situation Assessment and COA Analysis
- M&S for Spectrum Dominance & IW Effectiveness Evaluation
- Rapid M&S for Sensor Coverage Analysis

Improved Cognitive, HCI Support for Understanding
- Uncertainty Management and Visualization
- Cognitive Support and Decision Aids
- Speech and Text Understanding

Tools for the C2 and IW Defense of Grid
- IW Surveillance and Defense Tools
- Multilevel, Adaptive Infosec
- Anticipatory Services Management Tools Tools for Projecting and Visualizing Grid Capabilities in Terms of Operational Need

Robust Secure Real-Time Geolocation and Timing

Improved System Capability, Architecture, and Integration
- Real-Time, Distributed Object Management
- Easily Deployable, Evolvable, Scalable Plug and Play Architecture
- Low Cost Techniques for Appending Robust Front Ends and "Shells" to Commercially Derived Systems
- Massive Data Storage and Management

Support to Seamless Networking
- Automated Language and Syntax Translation
- Automated Protocol Translation
- Universal Information Transaction Mechanisms
- Advanced Compression, Coding, Abstraction for Conditioning of Information
- Self-Adapting Tactical/Mobile Networking
- Rapidly Deployable Tactical Fiber Extensions
- Multilingual, Multimode Interface Services
- Heterogeneous, Multimedia Conferencing

Intelligent Agent and Tool Support for Operational Functions
- Intelligent Agents for C4ISR Tasking
- Agents for Intelligent Inferencing
- Automatic Recognition, Routing, and Analysis of Data
- Intelligent Agents for Knowledge Retrieval, Filtering, Sanitization, and Deconfliction
- Automated Mediators and DBMS Tools

Technology Areas Needing Emphasis in the Technology Base

Of the 43 technologies discussed on the previous slide, 33 technologies were not found in the demonstration programs. These will require emphasis to achieve the functional capabilities envisioned by ABIS. As stated earlier, due to time constraints, the ABIS Task Force was unable to review the Basic Research Program. This review should be undertaken to ensure that the needed, but as yet immature, technologies for ABIS in the post-2000 timeframe are receiving adequate attention now in the DoD research program.

ABIS Technology Roadmap

To Lay the Foundation for ABIS, a Sustained, Concerted Effort Is Needed To Focus Research and Operational Demonstrations in Critical Areas

Fully Supporting Demos

Current

- **Effective Force Employment**
  - Precision Rapid Counter Multiple Rocket Launchers
  - Battlefield Combat ID
  - Synthetic Theater Of War 97
  - Advanced Joint Planning
  - C2 Joint Force Air Component Commander
  - Distributed Air Operations Center
  - Littoral Warfare RT EMI Management
  - Joint Logistics
- **Battlespace Awareness**
  - Precision SIGINT Targeting
  - Combat ID
  - Battlespace Command and Control
  - Battlefield Awareness and Data Dissemination
  - Semi-Automated Image Processing
- **Grid Services**
  - Digital Battlefield Communications
  - Multi-Band, Multi-Mode Radio
  - JTF Network Control
  - Survivable ATM

Near Term (1997 - 2000)

- **Effective Force Employment**
  - Integrated Fusion and Target Tracking
  - Automated Weapon-to-Target Pairing
  - Automated Target Recognition
  - Joint, Early Entry C4I for Rapid Force Projection
  - IW Battle Management
- **Battlespace Awareness**
  - Integrated Sensor Tasking
  - Real-Time Cognition Aiding Displays
  - Distributed Situation Assessment
- **Grid Services**
  - Robust Tactical/Mobile Networking
  - C4I for the Grid
  - Information Security

Long Term (2000-2010+)

- **Effective Force Employment**
  - Distributed Empowerment
  - Intelligent, Joint Force Automated Rules Of Engagement
  - Retasking and Rehearsal for Coordinated Operations Enroute and On-the-Move
  - Distributed Battlespace Opportunity Planning
  - Joint Information Warfare and Spectrum Dominance
  - Management of Dynamic Force Configurations
  - Adaptive Force Package Tailoring
- **Battlespace Awareness**
  - Knowledge-Based Information Presentation
  - Cognitive Mission Support to Warfighter
  - End-to-End Task Synchronized Mission Support Products to Warfighter
- **Grid Services**
  - Distributed Access to Consistent Information
  - Retrieval and Integration of Heterogeneous Information
  - Predictive Management of the Grid
  - Integrated Defense and Management of the Grid

Technology Base Areas

- **Effective Force Employment**
  - Automated Planning and Reasoning Tools
  - Fast Running Modeling &Simulation
- **Battlespace Awareness**
  - Improved Intelligence Processing and Fusion
  - Improved Human Computer Interface and Cognitive Support
  - IW Event Detection, Classification, and Tracking
- **Grid Services**
  - Intelligent Agent and Tool Support for Operational Functions
  - Support to Seamless Networking
  - Tools for the Management and Defense of Grid
  - Improved System Capability, Architecture and Integration
  - Robust, Secure, Real-Time Geolocation and Timing

ABIS Technology Roadmap

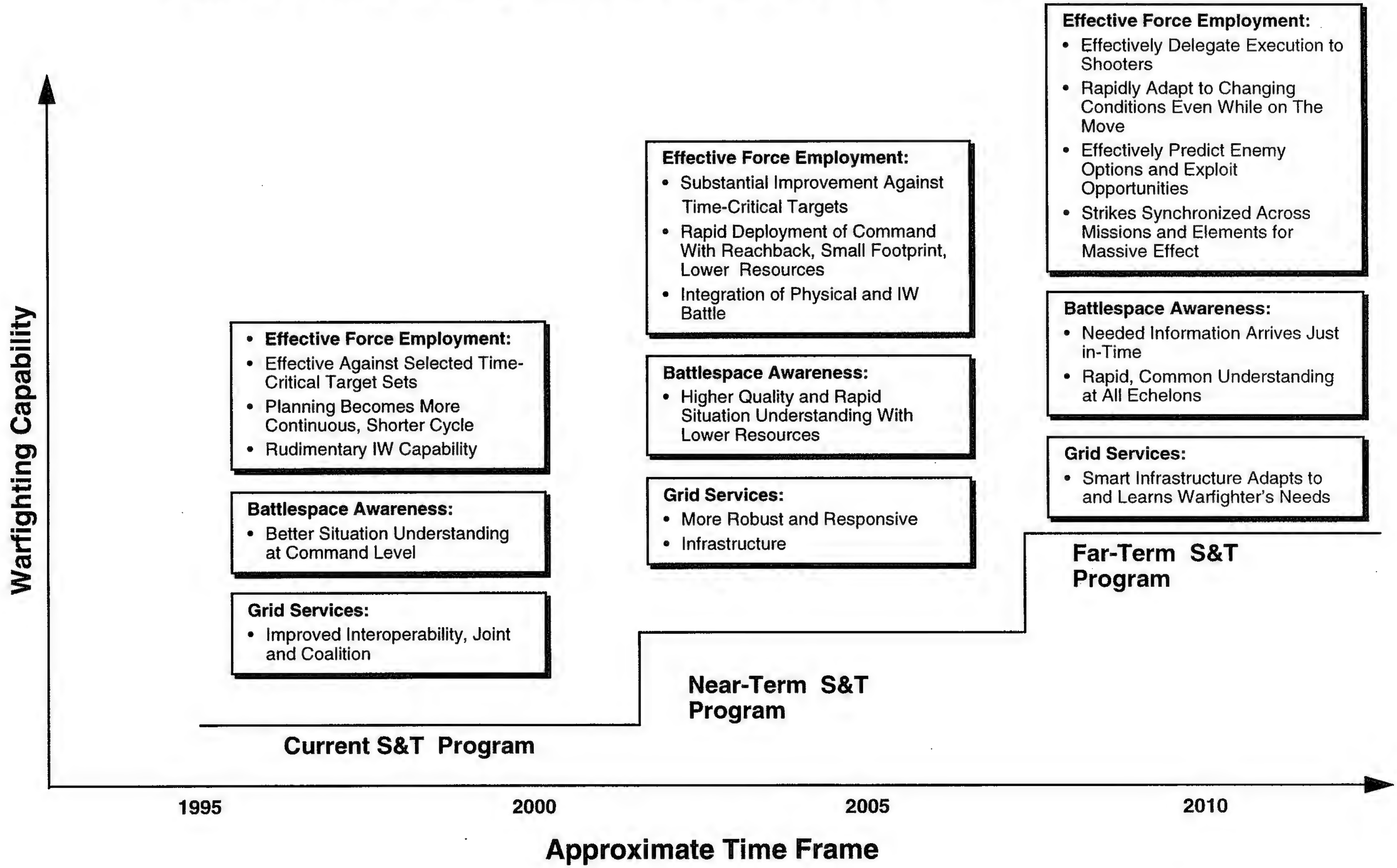
The ABIS of the future depends on advanced information technologies—from microelectronics to software. The United States has an advantage in achieving the ABIS vision because it leads the world in both technology and economic market dominance in many of these technologies. Realizing the ABIS vision requires a sustained investment in the further development of a broad base of information technologies as well as the demonstration of military systems that support the functional capabilities operators require. Harnessing technology to sustain military information superiority is a continuing competition. Meaningful capabilities can be realized and incrementally enhanced over time.

The ABIS Task Force developed a technology roadmap to depict continued technology developments and incremental demonstrations. A rich set of demonstrations that support the emergence of the ABIS are currently in progress within the defense technology program.

The box labeled Technology Base Areas lists generic technology areas where advances are promising. Incremental and rapid progress will be made over the next several decades in most of these areas. It is these incremental improvements that feed near-term demonstrations (1997-2000) and long-term demonstrations (2000-2010). Long-term demonstrations will not be possible without success in selected technology base efforts. For example, consider Grid Services as one of the three layers of the capability framework. Current demonstrations focus on improving modularity, connectivity, and network management. Near-term demonstrations build on emerging technology and provide enhanced security, defense of the grid from information warfare attack, and management of a grid with hundreds of thousands of connected nodes. Near-term demonstrations also provide predictive management of grid resources to respond to command priorities, better connectivity to lower level tactical units and better interfacing between heterogeneous networks. Long-term demonstrations, on the other hand, will deliver sophisticated automated and continuous assistance to individual users as well as more significant security and defensive features.

The specific technical or operational advantage that an information product or systems application delivers will erode over time. Continual assimilation and enhancement of new technologies, products, and military applications are necessary to retain information superiority and maintain military dominance. Technology will continue to improve rapidly with relatively easy access to individual commercial technology products. Therefore, even relatively unsophisticated adversaries may purchase individual components that are world-class. To retain military superiority, the United States will have to sustain a long-term, focused investment in a broad array of enabling technologies and experiments associated with potentially desirable command and control capabilities. Furthermore, these enhancements will have to be demonstrated and fielded incrementally into the integrated, unified ABIS.

Time-Phased Improvement in Operational Capability



Time-Phased Improvement in Operational Capability

Each step in the technology roadmap will provide a corresponding improvement in needed operational capability if integrated and fielded. This figure describes potential time-phased improvement leading to a fully realized ABIS by 2010.

Realization of the system level incremental improvements leading to the JCS joint vision of overwhelming dominance in the battlespace will require a continuing long-term commitment. These system efforts, coupled with the projected continued doubling performance of underlying information system hardware every 2 years, should result in significant incremental improvements in the warfighters' visibility and command of the battlespace as well as in the availability of accurate, detailed data needed for sensor-to-shooter concepts.

Between now and the year 2000, demonstrated capability improvements in force employment will be based largely on better target recognition and timely attack, beginnings of a defensive IW capability, and an improved planning capability. Battlespace awareness is to be improved by providing a consistent situational picture and an ability for integrated tasking of sensor assets. Grid capabilities will be improved to support rapid configuration of tactical networks and improved interoperability of radio networks.

In the midterm (2000-2005), further system improvements in force employment would be possible by wider dissemination of a commander's intent and improved C2 early in the campaign. Improved automated tools for weapon-to-target pairing and intelligence processing will allow substantial improvement against time critical targets. Battlespace awareness will be enhanced by continually projecting friendly and enemy moves and their outcomes, by adaptively supporting cognitive functions of diverse users, and by providing tailored information for mission execution when and where needed. Grid capabilities will be made more robust by advances in defensive IW, and by providing end users with an ability to tailor and adapt their information environment and access to information.

In the longer term (2005-2010), continued evolution of operational concepts and availability of new technology will provide a basis for full development of ABIS concepts.

Key Benefits of Pursuing ABIS

Significantly improved system capabilities

- Tailorable, flexible, robust information environment
- Wide availability of needed knowledge
- Information access separate from C2 hierarchy and process
- Global support to mobile warfighters

Supports

Fundamental changes in C2 concepts

- Adaptive learning organization
- Flexible command modes
- Improved speed of command
- Empowered execution

Enables

New force employment concepts

- Shape the battlespace
- Control the pace and phasing of engagements
- Mass of synchronous effects from dispersed forces

Keeping pace with the changing character of warfare and maintaining supremacy into the 21st century

Key Benefits of Pursuing ABIS

ABIS addresses enhancements in warfighting effectiveness and efficiency over the long term through an orderly sequence of actions to adapt operational concepts and procedures, and information technology to the emerging national security environment of the next century. Each step in this sequence, or roadmap, is intended to provide both evolutionary and revolutionary improvements in a way that can be accommodated within the existing operational and technical frameworks. The challenge is to define appropriate time-phased goals and to coordinate the development and assimilation within the forces of the operational concepts and the technologies consistent with the long-term objective.

The bullets in this figure denote the focal points of the concept. In each area, the long-term objectives are aimed at revolutionary enhancements that may result in fundamental changes in the way that forces are organized, commanded, and operated. In some cases, changes to basic doctrine and even roles and missions may be needed. These changes will have to evolve in a way that is suitable to the warfighters and that does not compromise the existing state of readiness of the forces. In other cases, the changes may be enhancements in processes or systems that are compatible with existing doctrine.

Clearly, implementation of such an ambitious and "politically charged" initiative will be difficult. The substantial benefits offer potential reductions in costs through extensive automation of processes that are now laborious and time consuming. The benefits also offer speed and flexibility in organizing, deploying, and operating forces and in the application of expensive but highly effective weapons and sensors. The capabilities derived from the benefits can be the basis of military advantage within a battlespace. However, these benefits will not be realized without some pain. DoD will have to finance new technology to replace existing systems, and the funds will have to be taken from the shrinking budgets being divided among current programs. The operators will also have to be committed to revising concepts, doctrine, and organizational structures that are strongly embedded in military culture and practice.

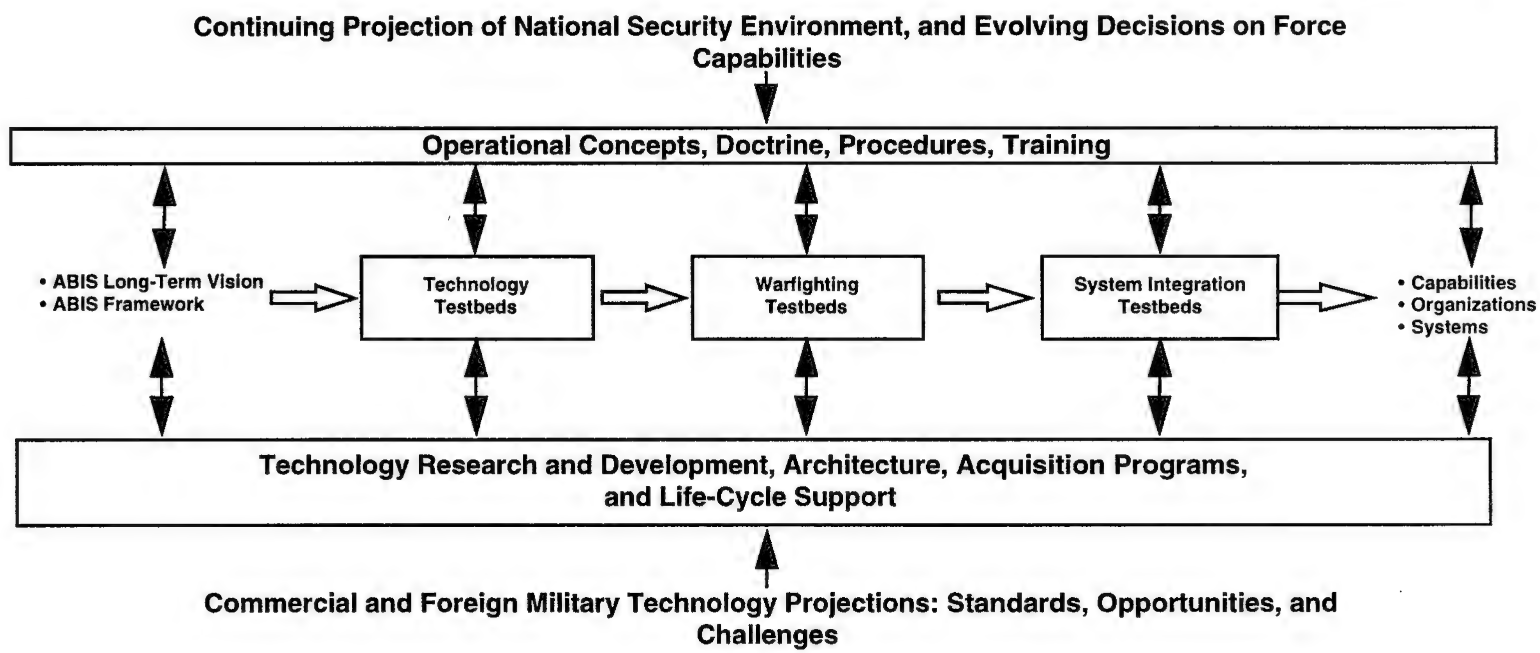
Motivation toward the objective and willingness to confront and solve difficult problems are summed in the assertion at the bottom of the figure. The United States must remain militarily dominant in any future conflict, and to do so we must take advantage of the information technology "explosion" as a way to provide an efficient and cost-effective military capability and to keep ahead of potential adversaries who have access to the same commercial information technology.

The following discussions address the approach and strategy for moving toward the ABIS vision.

5. Evolution of the ABIS Construct

The Implemention of ABIS is an Evolutionary Process

Fielding ABIS Capabilities Requires Incremental Insertion, Adaptation, and Assimilation of New Operational Concepts and Technologies, Guided by a Single Long-Term Vision and a Broad Community of Participants



The Implementation of ABIS is and Evolutionary Process

Moving from operational concepts and technology programs to actual implementation and user assimilation on a broad scale represents a major challenge. Together the operational and technical communities are capable of better judgments than either is alone. This was a powerful lesson learned by the ABIS Task Force.

The process illustrated in the figure provides a mechanism to couple the command and control activities of the operational and technology communities. The process is evolutionary and it is iterative. Today, it is information technology that gives rise to the ABIS vision and framework. ABIS, in turn, will stimulate changes in current operational concepts, doctrine and procedures, which, in turn, will drive technology to support these changes.

These operational concepts and technologies are shaped, over time, by feedback from testbeds aimed at determining feasibility and operational effectiveness. The testbeds serve as laboratories where operators can experiment with new technology within a simulated real world operational context to determine the extent to which technology will support needed command and control functions and enable new operational concepts. In addition, testbeds can be used to understand systems integration and procedural impacts of inserting new capabilities into evolving systems. These testbeds may be single locations, such as a battle laboratory, or they may be distributed across multiple, electronically linked locations.

The horizontal bars and arrows at the top and bottom of the figure indicate the continuous interaction of the broad operational and technical communities. The intent is to provide a rapid and smooth transition from concept exploration through system implementation, life cycle support, and operational training within a common ABIS framework. The process must provide for the coordination of planning, architecture, and collaborative integration and evaluation activities; and the rapid incorporation of incremental capability packages into system acquisition, life-cycle support, and training programs.

This process implies a strong integration of activities among organizations on both the operational and technology sides of DoD. On the technology side, the R&D community will have to work closely with acquisition organizations. On the operational side, advanced concepts and doctrine development will have to be matched by education and training, and reinforced using simulators and exercises to assimilate the new capabilities into the operational forces.

The ABIS vision and framework provide a focus for these community interactions, as well as for the selection of technology and operational concepts.

Implementation Principles

- Coordinated Operational and Technical Evolution
  - Experimentation, Evaluation, and Feedback To Expedite and Validate New Concepts, Requirements, and Technical Approaches
  - Integrated Operational and Technology Planning
- DoD Guidance To Enable and Expedite Progress
  - A Long-Term "Vector" Toward the Vision
  - Incremental Goals With Migration Strategy
  - Evolutionary, Time-Phased Architecture
  - Focus on Federated, Heterogeneous Capabilities
- Operational Concept Development To Assist Technology Assimilation
  - Operational Experimentation to Refine Concepts to Lead Insertion of New Technology Into Operational Environment
  - Education To Train Users and Adjust Processes and Procedures
  - Exercises To Build User Proficiency and Confidence
- Coordinated Technology Development, Acquisition, and Life-Cycle Support
  - Early and Continuing Partnership With the Acquisition and the Support Commands
  - Acquisition and Life Cycle Support Integral to Technology Initiatives
  - Test and Evaluation, and Contracting Need To Be Adjusted To Better Support the Process

Implementation Principles

The principles listed in this figure are central to the ABIS evolution process.

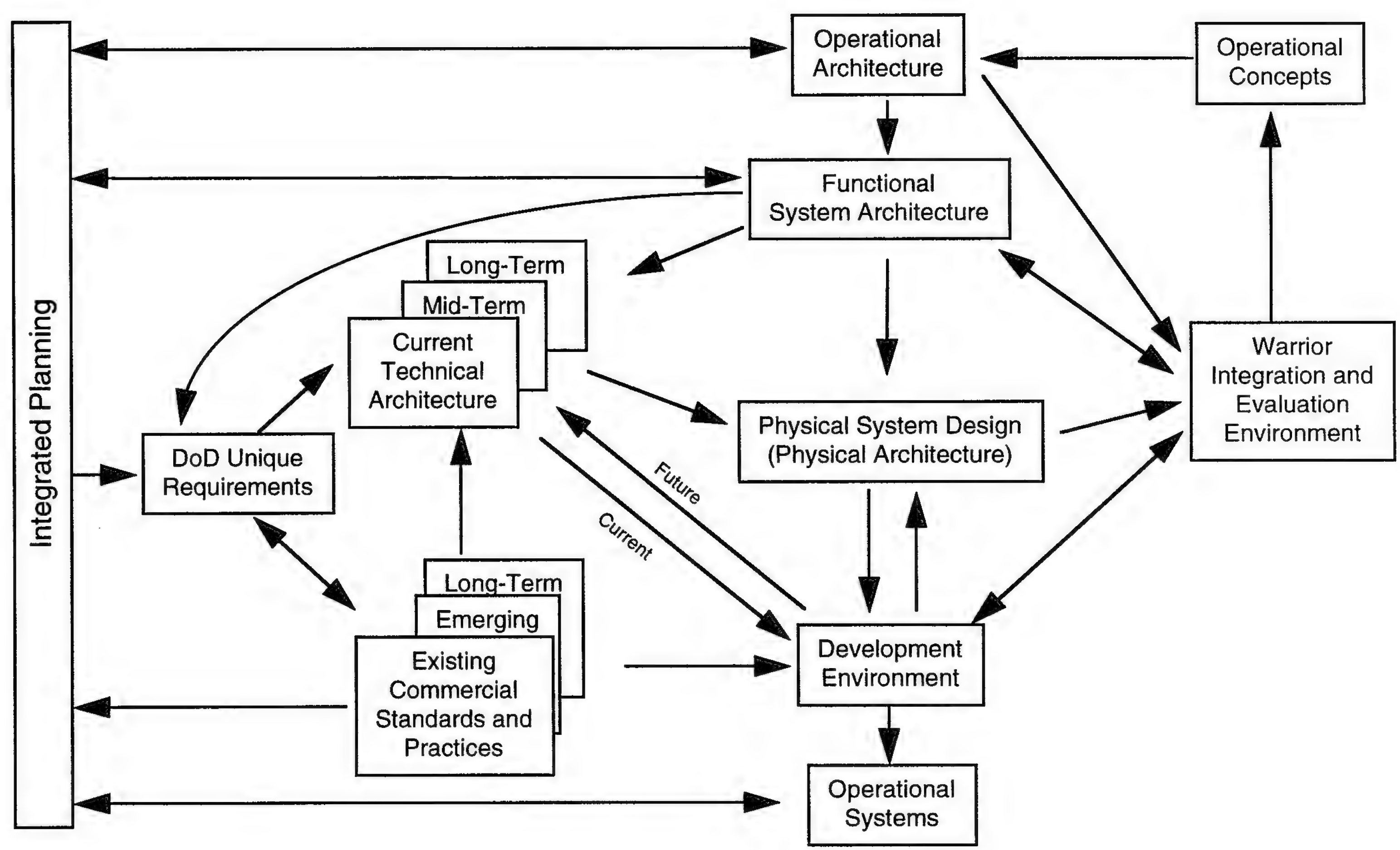
Integration of the operational and technical evolution processes is essential. Mechanisms must be set in place to make this happen. The ABIS Task Force was an important first step, but is insufficient by itself. More substantial efforts to establish and maintain close coupling between users and system developers needs to extend from planning and budgeting to program execution and operational practice.

DoD guidance is another essential part of the process. Guidance needs to balance the forward look toward the vision, and the near-term focus on readiness, sustainability, and interoperability among existing forces and systems. The long-term vision is the ultimate goal of evolution, but the steps toward that goal need to be incremental, along the proper vector and consistent with DoD's ability to insert and assimilate the enhancements. We will need a time-phased architecture and a view toward managing the complex system-of-systems in ways that support both current capabilities and future enhancements. We cannot afford to be too constrained by current concepts and systems, but we also cannot afford to ignore the realities of the difficulty of obtaining new investments and the need for affordability, sustainability and interoperability at each stage. DoD guidance must accommodate and facilitate a system-of-systems in which heterogeneity and continual change are principal factors.

As new capabilities are developed, they must be inserted and assimilated into an operational environment that includes both users and systems that work together according to well-defined concepts, procedures, and practices. The enhancements will influence how tasks are executed and how people and systems interact. Education, training, and exercises will play important roles in assimilating the capabilities. They must precede the introduction of the new equipment and concepts and yet be just as timely as the materiel enhancements so that the forces can adapt quickly and efficiently and that overall readiness is maintained and improved.

The vital role of the materiel community in ABIS evolution is evident. This community acquires, fields, manages, and sustains the systems. Current DoD processes tend to separate acquisition and life cycle support from advanced research and development. The result is often a decoupling of the technology vision and the corresponding advanced operational concept vision from the reality of the system acquisition process. Advanced prototypes and concepts are developed, or even fielded, and often become "orphaned" or are not interoperable with existing systems. Frequently, systems acquisition efforts call for "technology insertion," which is not really coupled to what the technology community is doing. This needs to be changed. We need to accelerate acquisition of state-of-the-shelf technology and bring together prototype and demonstration capabilities with formal acquisition efforts in a way that ensures reliable life cycle support and end-to-end system integrity and interoperability.

Integrated Planning, Architecture, and Operational Test, Evaluation, and Refinement



Integrated Planning, Architecture, and Operational Test, Evaluation, and Refinement

This figure is adapted and expanded from a recent study entitled "Integration and Modernization of Joint Land Warfare," directed by the Center for Information Systems Architecture, under tasking from ASD (C3I) and the Undersecretary of the Army.

The modified figure illustrates the interactive nature of various architectures both with integrated planning and with ABIS experimentation and evaluation environments wherein evolving technologies and operational concepts can be evaluated and refined.

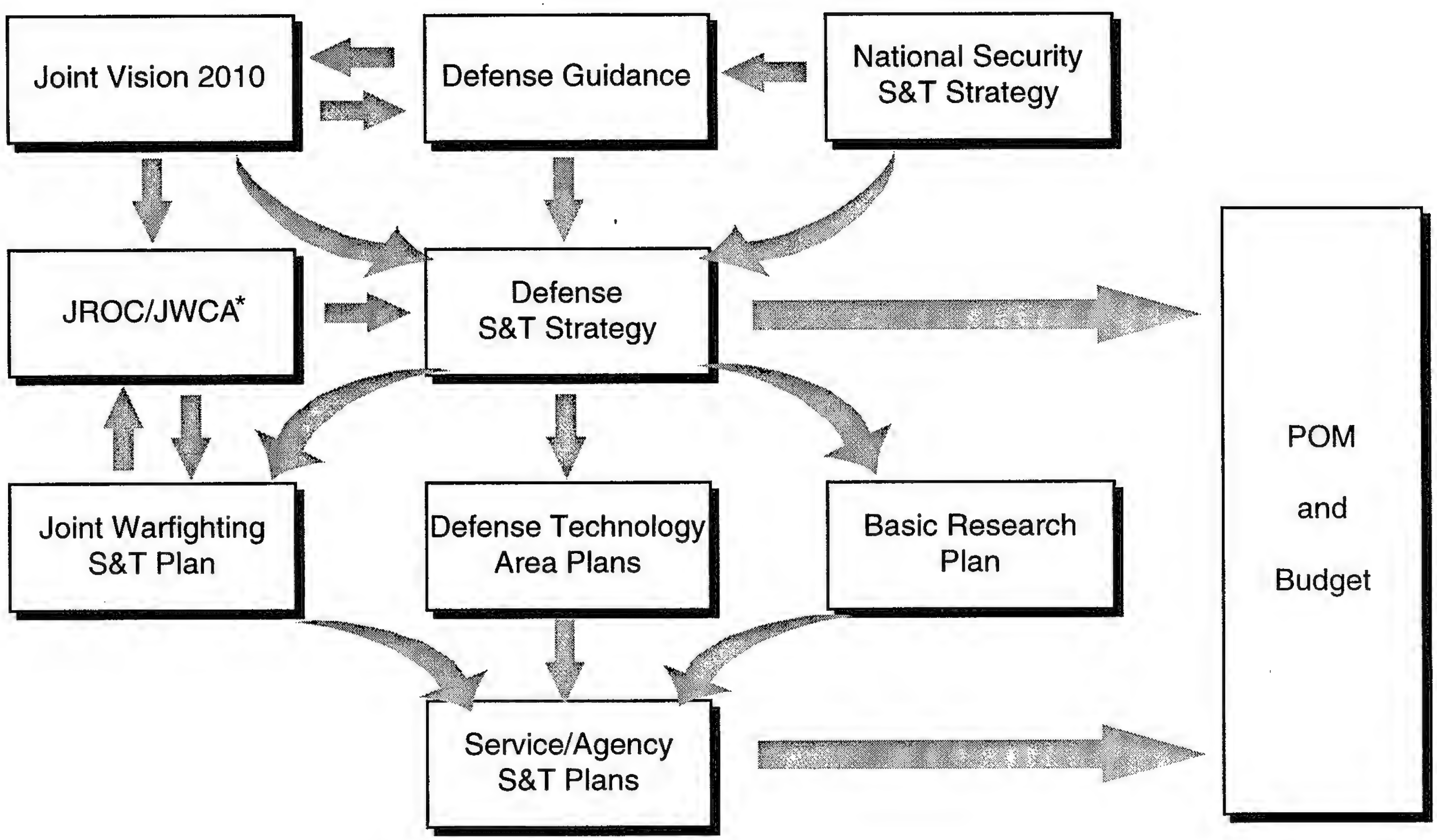
Operational and functional architectures are depicted in the upper right of the figure. This is the process reengineering that results in adaptation of operational concepts. It is supported by warfighting experiments that allow users and developers to evaluate and refine new concepts that could be supported by current and emerging technologies. This notion of collaborative concept-technology experimentation and coordinated evolution of the operational and functional architectures is an important principle in ABIS evolution.

The left side of the figure depicts the interaction of DoD requirements with technical architectures (standards and practices). The technical architecture, in turn, needs to be consistent with accepted commercial standards and practices and with emerging new standards and practices that could become important in the future. Technical architecture also needs to recognize that some military requirements may not be satisfied by the commercial marketplace. The use of layered technical architectures implies that there can and probably will be different sets of guidance for different time frames. The three time-referenced technical architectures must ensure compatibility and interoperability as the system evolves, especially when new features and standards are implied in the future.

The right bottom of the figure shows how the functional architecture is instantiated at any point in time by a physical system design which utilizes the technical architecture to develop and field actual operational systems.

The vertical bar at the extreme left of the figure shows that overall planning needs to be integrated across the operational, functional, and system areas to ensure that they are mutually consistent. It also shows that the commercial marketplace is a major driver in this planning and that the DoD-unique requirements are developed after careful consideration of the ability of commercial products to meet the demands of a functional architecture.

Science and Technology Planning



* Joint Requirements Oversight Council/Joint Warfighting Capability Assessment

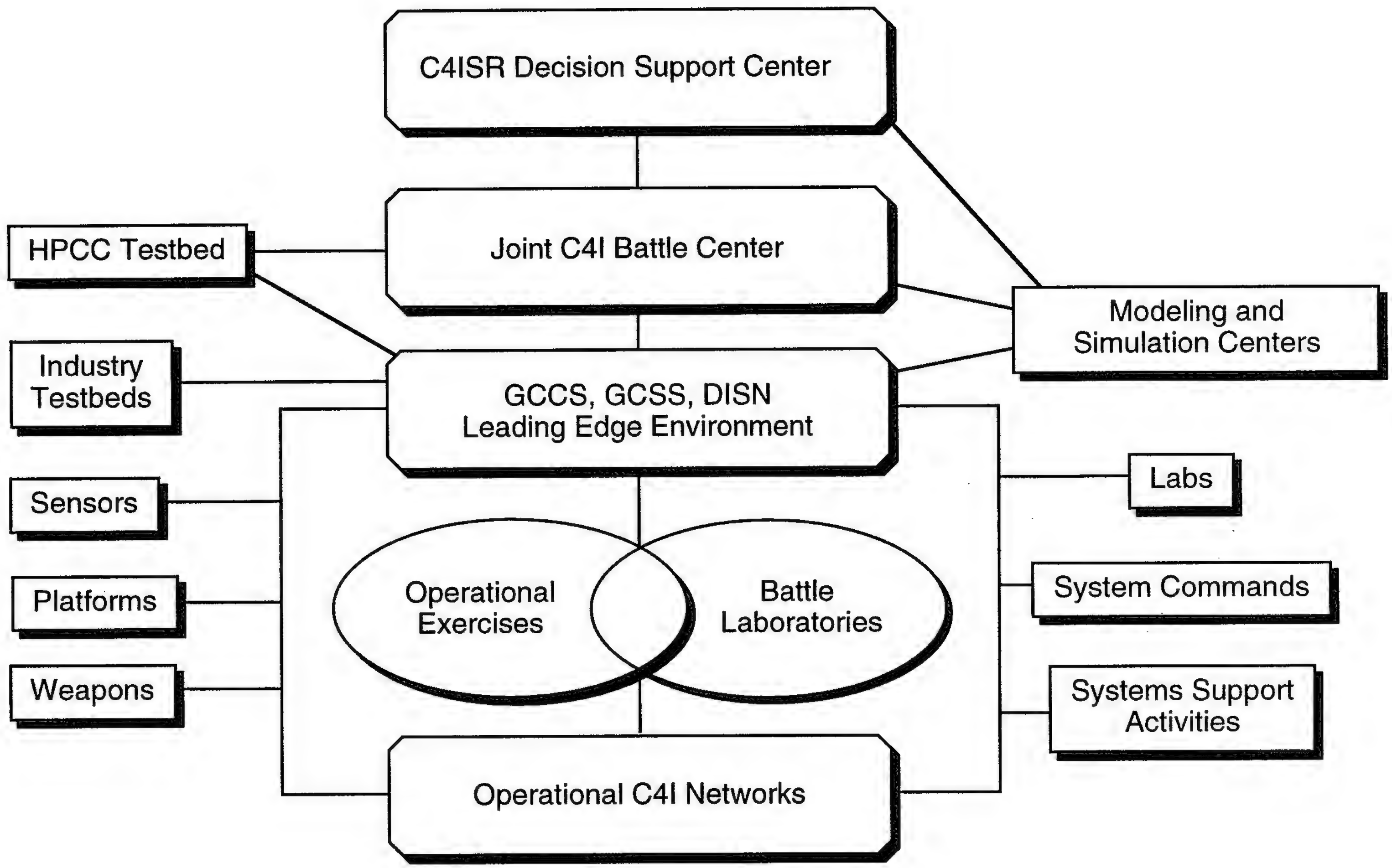
Science and Technology Planning

Evolution toward ABIS objectives will be guided by planning processes that shape DoD policies and investments based on the integrated operational-technical vision. High-level guidance is provided by a combination of joint operational vision, defense guidance, and national technology strategy. These combine to produce an overall definition of joint operational requirements and priorities and an S&T strategy for DoD, all of which serve to develop POM guidance. The Joint Requirements Oversight Council (JROC) plays a pivotal role in interpreting high-level guidance in terms of requirements and priorities, and interacts with technology and acquisition organizations in DoD to develop strategy and to validate its objectives and priorities. The overall S&T strategy is not static; rather, it evolves in concert with evolving operational and technical visions and objectives, developed and coordinated through the extensive experimentation and evaluation processes depicted in the preceding figure. Consequently, it provides POM guidance that both tracks and expedites evolving concepts and is, therefore, a critical element in support of the RMA process within DoD.

The S&T strategy also drives the development of the three focal area plans shown in this figure: the Basic Research Plan, the Defense Technology Area Plans, and the Joint Warfighting S&T Plan. These plans interpret the S&T strategy regarding specific objectives and investments to develop critical enabling technologies, to use them to build systems that provide required functional capabilities, and to integrate across technology areas to build operational capabilities.

Each of the three focal area plans presents an integrated, joint view of the needed technology investments and objectives. They are the drivers for the service and agency S&T plans that are the actual investment planning inputs to the POM. The services and agencies are the executive agents for building the systems. They define objectives and funding requirements to carry out their part of the process. Their inputs to the POM process provide the specific definition of actions and resource requirements to support the higher level guidance provided in the S&T strategy.

Extensive Use of Testbeds, Laboratories, and Exercises



Extensive Use of Testbeds, Laboratories, and Exercises

Continual testing, evaluation, and feedback are central to the ABIS evolution strategy. These processes are essential to provide not only the hands-on understanding needed to guide accelerated acquisition, but also the mechanism to ensure that operational and technical plans and programs are integrated and mutually consistent. Consequently, testbeds, laboratories, and exercises are key elements in the process.

The DoD C4ISR community has a number of testbeds for operational and technology development purposes, and many of them are being connected to form distributed "virtual" testbeds that can be important contributors to ABIS evolution. The availability of secure wideband communications, through activities such as the ARPA-DISA Advanced Information Services Joint Program Office, makes it possible to construct distributed testbed environments that allow significant experimentation and evaluation to take place, with many different participants at many different locations.

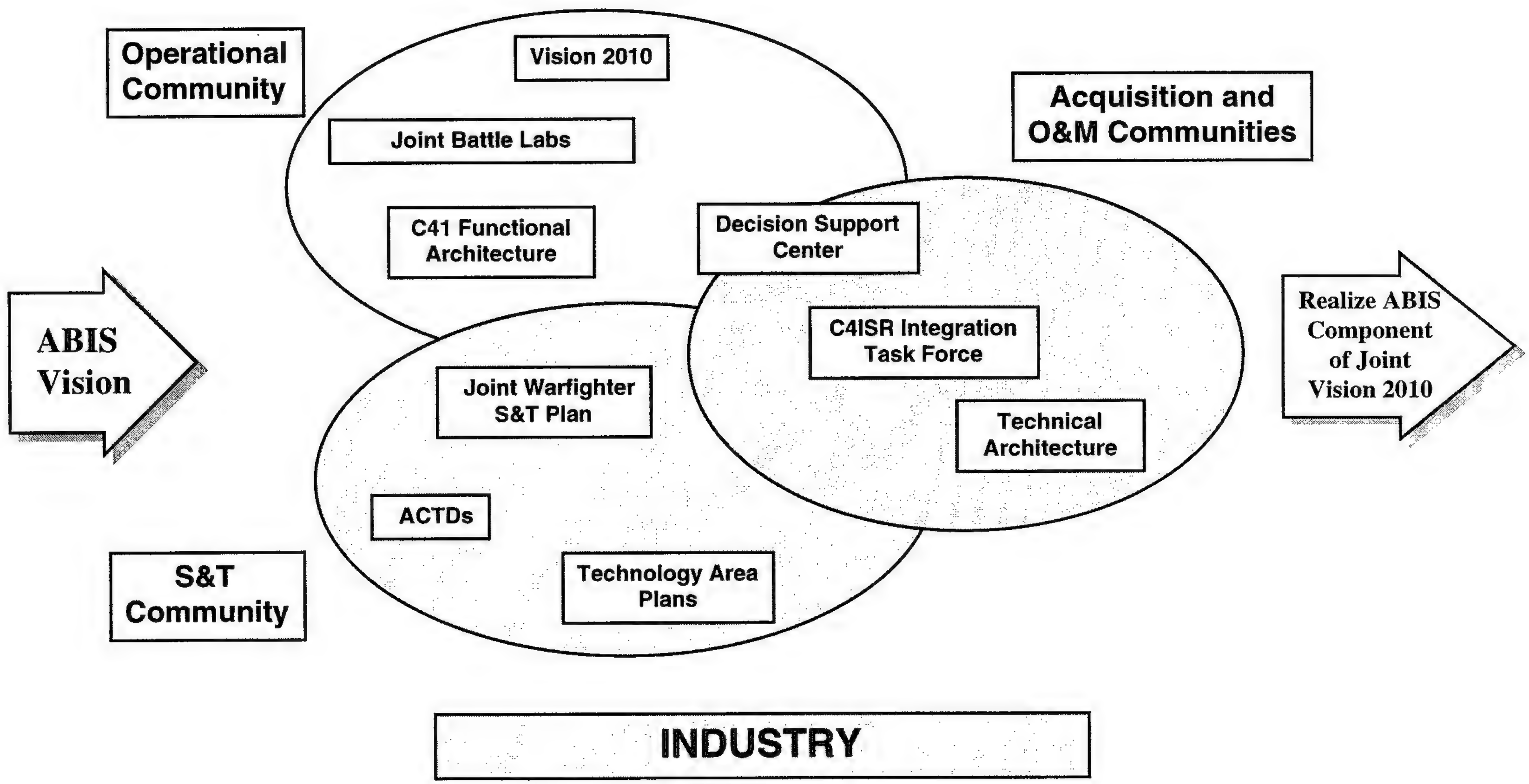
The proposed ABIS demonstrations focus on broader operational and functional capabilities than most of today's demonstration programs. The ABIS demonstrations would integrate a number of technology building blocks into more operationally meaningful command and control capability segments. System integration, a key part of testbed activity, is an advancing technology itself and a challenging issue. The proposed demonstrations are an important mechanism for accelerating the development of new operational concepts and the integration of new system capabilities. These demonstrations are aimed at validating operational value; refining the technical approach and operational concepts; and understanding system integration, architecture and doctrinal issues and their interrelationship.

This figure illustrates a notional distributed, virtual testbed environment that integrates DoD testbeds, training and exercise environments, and R&D environments. The distributed environment is also connected to key DoD decision support facilities and modeling and simulation facilities. With proper planning and well-designed experiments, this infrastructure can provide a rich environment for the necessary interaction of diverse parts of the community. It can also provide the mechanism for understanding and making decisions about operational capabilities and training, and system factors while gauging the maturity of the technologies that enable those capabilities.

The "core" distributed environment can be augmented with specialized testbeds for sensors, weapons, and platforms as well as high-performance computing. It can also be extended to include appropriate R&D facilities in DoD and in industry. This would further facilitate coordination and integration of efforts.

Initial Steps Toward the Vision

There are a Number of Activities Capitalizing on ABIS Results



Initial Steps Toward the Vision

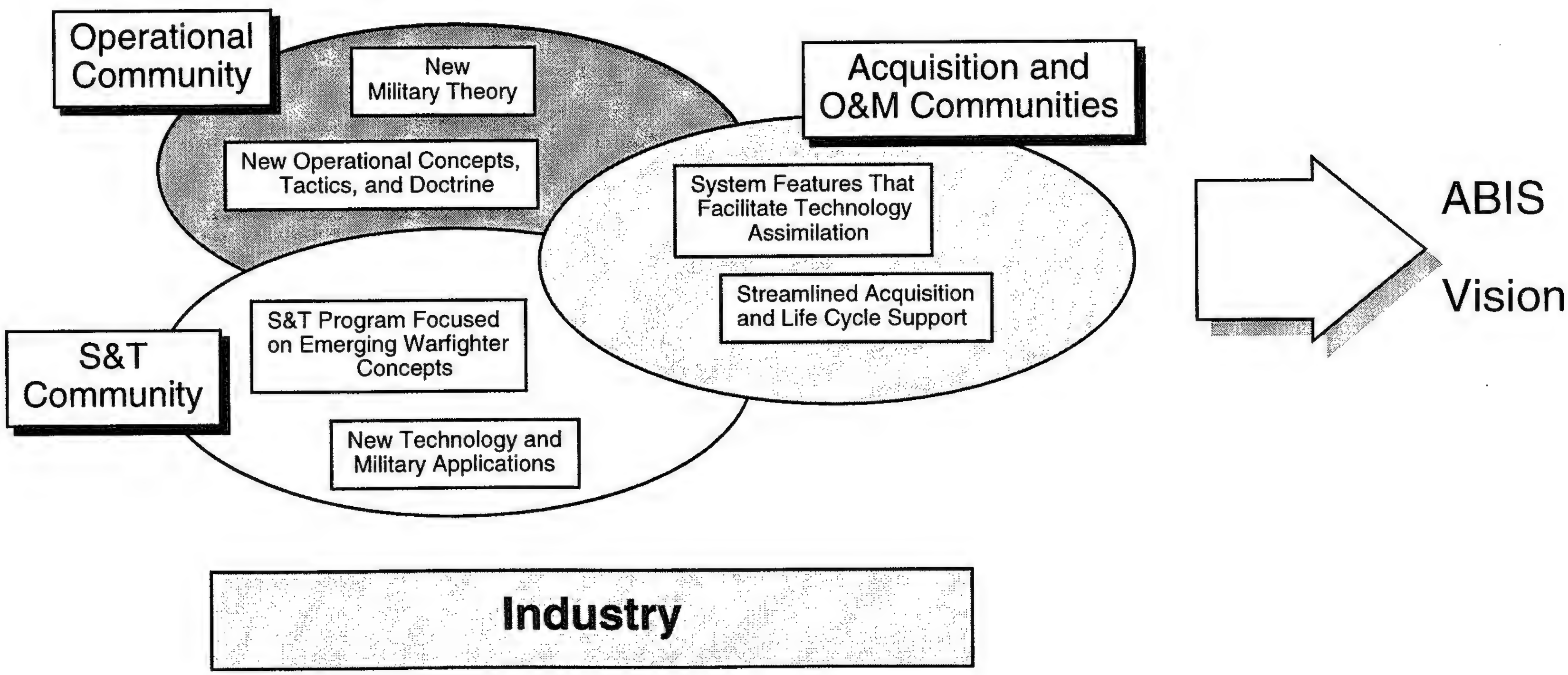
The ABIS study has produced substantive near-term benefits. It served as the catalyst that stimulated the examination of architectural elements that can be incorporated into a Joint Staff operational architecture to support Joint Vision 2010. There is a sequence of studies that addresses various aspects of that architecture; ABIS is one such study. Because information superiority integrates our sensors, weapons, and forces and thus enables them to be more effective, an advanced information system is a key element in the operational architecture required to achieve the Chairman's Joint Vision 2010.

Results have already been incorporated into Science and Technology planning. In particular, the ABIS Study results appear in the Joint Warfighting Science and Technology Plan which was developed jointly by the Joint Staff and the Office of the Secretary of Defense. That plan identifies the key technologies to support twelve of the highest priority needs approved by the Joint Requirements Oversight Council. The ABIS study specifically addressed three of those objectives: Information Security, Precision Force, and Information Warfare. Furthermore, the planners used the ABIS mapping methodology to identify enabling technologies and the Defense Technology Objectives that would provide the crucial building blocks necessary to achieve these three Joint Warfighting Capability Objectives.

Clearly, new operational concepts and revolutionary technology are not enough. Operators can explore new operational concepts that take advantage of emerging technologies, and scientists can explore new technologies that enable new operational concepts. However, whether new technologies will find their way into fielded systems—the systems required to realize the ABIS component of Joint Vision 2010—is predicated on two factors: 1. The DoD must be willing and able to streamline the acquisition process. 2. Commercial information products and technologies must be incrementally injected incrementally into the future Advanced Battlespace Information System as it evolves from our command and control support systems.

Changing the Way We Do Business

To Rapidly Develop and Assimilate New Operational Concepts and Technology, We Must Change the Way That We Do Business in Several Key Areas.



Changing the Way We Do Business

In addition to the increased participation and interaction among the operational, technology and acquisition communities, structuring an ABIS process to produce a "capability-based force" will require changes in the way that each of these communities does business. In part, this is because a *capability-based* process must represent a consolidated view of the operational, technological, acquisition and O&M communities. And, in part, it is because changes such as *acquisition reform* must occur to reflect the changed national security environment of the current era.

The operational community will have to place greater emphasis on the continued development and application of new military theory and the associated doctrine and tactics, and operational concepts enabled by emerging technology in schools and training programs. This will require continual reeducation and training of military personnel in the use of modern technology. The science and technology community will have to better focus its efforts on the enabling technology for future warfighting concepts and continue to search out the most valuable new technology and applications in these areas in a timely way. The acquisition and O&M communities will have to streamline processes for acquiring technology and evolving systems on a continuing basis, to reduce costs and to expedite the process.

In each of these areas, important new DoD planning, architecture, and testbed initiatives are emerging. These initiatives need to be integrated and extended to include a broader range of participants. In addition, much more remains to be done to strengthen these mechanisms and make them a part of the formal DoD organization and acquisition process. This effort must explicitly improve the process for integrating system components based on new technology into evolving systems, and to evaluate the contribution to operational effectiveness attained by enhancing specific operational capability threads (as opposed to upgrading an entire system). For each of these areas, strawman attainable goals, a strategy to achieve them, and a potential collaborative team from DoD, industry, and academia have been identified by the Task Force to assist in guiding the evolution of ABIS.

Representative Strategies

Military Theory and Practice of Command

- Advanced Command Concept Curricula at Joint and Service Schools
- Advanced Command Concepts Wargame and CPX Series
- Use Warfighting Labs and Leading Edge Environments to Support Schools, Wargames, CPXs
- Emphasize Research on Cognitive Aspects of Intuitive Decisionmaking
- Use Simulation and Artificial Intelligence To Better Understand Predictive Situation and Course of Action Evaluation

Military Application of a Wide Base of Information Technology

- Use Warfighting Labs as Proving Ground for Insertion of Technology and Adaptation of Systems and Processes
- Provide Automation To Accomplish Routine Tasks and Gain User Confidence as Replacements for Staff
- Make Day-to-Day Information Technology Environment Identical to Deployed Warfighting Systems Environment
- Focus ATDs on Feasibility, ACTDs on System and Concept Adaptation and Evaluation
- Focus on Aggregate Operational Capability Packages of Multiple Technical Demonstrations
- Establish Partnership With Industry To Help Evaluate and Adapt Commercial Technologies

Operational Concepts, Tactics, and Doctrine

- Establish Multiservice Distributed Warfighting Laboratory With Leading Edge Capability
- Provide Seamless Interface between Simulation and C2 Systems To Provide "Vicarious Training"
- Integrate Operational, Intelligence, and Support Staffs at Operational Level and Below; and also Current and Future Operations, Plans
- Establish Common, Joint Taxonomies, Procedures, and Practices for Integrated Combined Arms Operations
- Emphasize Integrated, Joint Operations in Exercises

System Constructs That Facilitate Assimilation and Flexibility of Use

- Forward Compatibility Through Technology Insertion To Accommodate New Capabilities
- Develop Time-Phased Architecture That Extends From Present to Long-Term
- Mandate Open System Standards and Practices Consistent With Commercial Practice
- Establish Common Taxonomy and Models for Information: Data Elements, Objects, and So on
- Design Systems To Facilitate Unplanned, Contingency Interfaces and Reconfigurations in the Field

Technology Development Focused Closely on Users' Emerging Concepts and Requirements

- Continue Close Partnership Between J3/J6 and DDR&E Developed in the ABIS Task Force
- Provide Common Documentation of Operational and Technical Objectives
- Increase Contribution of DoD Labs and Materiel Organizations to the Requirements Oversight Process
- Increase Contribution of Operational Community to DoD S&T Program Planning
- Increase emphasis on JWF S&T Strategy and Defense Tech Area Plans

Changes in Processes To Facilitate Technology Insertion and Assimilation

- Emphasize "Speed of Command" as an Element of Combat Power in Joint and Service Schools
- Achieve Timely Capabilities Consistent With Best Fit of Technology to Operational Priorities: the "80% Solution"
- Expedite Program Justification by Using Interactive Operational-Technical Experimentation
- Practice Evolutionary Development and Fielding, Including in the T&E and Contracting Process
- Design Systems To Facilitate Frequent Upgrades

Representative Strategies

The preceding figure identifies six important areas where changes will be needed as we evolve toward the ABIS objectives. To convey to the broader C4ISR community the breadth of these changes, we identified an initial set of strategies and key players that would be part of each of the six major areas. Those sets are presented and discussed in Volume VI, Annex D.

The figure condenses the material contained in Volume VI, Annex D. It provides a summary overview of the scope and nature of the numerous and varied changes needed and the approaches to making those changes. Such changes are an integral part of realizing the ABIS construct.

6. Summary

ABIS Task Force Summary

The Need

An Advanced Battlespace Information System for the 21st Century Is a Major Opportunity.

- Allows the United States To Remain Militarily Superior Through the Ongoing Revolution in Military Affairs
- Maximizes the Effectiveness of Investments in Sensors and Weapon Platforms

The Vision

ABIS Will Provide a Significant New Capability.

- A Knowledge-Based C4I System Environment That Facilitates Revolutionary Operational Capability by Enabling Warfighters To Rapidly Acquire and Use All Available Information

The Framework

The ABIS Task Force Identified and Integrated the Key Elements.

- Operational Capabilities for 2010
- Needed Critical C2 Functions
- A Broad System Construct
- Time-Phased Operational and Technical Demonstrations, and Technology Base Programs

The Implementation Strategy

Timely Implementation of ABIS Requires Broad Participation in a New Way of Doing Business.

- Continual Assimilation and Utilization of Advanced Information Technology
- Concurrent Advances in Force Employment, and Command and Control Concepts
- Increased Focus and Coordination Within the Operational, Doctrine and Training, Science and Technology, and Acquisition and O&M Communities
- A Process That Emphasizes the Use of Testbeds to Coordinate Planning, Architecture, and a Collaborative Integration and Evaluation Environment, With Rapid Incorporation Into System Acquisition, O&M and Training Programs.

ABIS Task Force Summary

The operational application of information technology will be key to U.S. military strategy as we enter the 21st century. Joint Vision 2010 recognizes this and emphasizes the broad use of advanced information technologies to significantly improve traditional military capabilities. Joint Vision 2010 also emphasizes protection of our information capabilities and the degradation of an adversary's ability to use his own command and control systems (i.e. information warfare). Understanding the implications of this vision and identifying needed capabilities and enabling programs is a challenging task.

The key product of the Task Force is a strategic capability framework for the Advanced Battlespace Information System. It identifies operational capabilities needed for 2010, maps them to critical command and control functions, and then to the technologies that enable performance of those needed functions. The framework also outlines a broad system construct that follows the principles of a federation. The federated system would provide warfighters with a robust, flexible, knowledge based environment of information and communication services. Achieving the ABIS concept requires the continual integration and use of rapidly advancing information technologies as a key element in maintaining global military superiority. The ABIS framework also provides a guide for sustained investment in a broad set of identified enabling information technologies coupled with a time-phased set of specific operational and technical demonstrations.

Achieving timely advances in combat power in the field requires a number of DoD functional organizations to interact in accordance with the long term ABIS vision and framework. The Task Force outlined a strategy for achieving this. The strategy emphasizes the interaction of users, concept developers, technologists, and system developers in a set of experiments and demonstrations within a network of advanced technology testbeds. This testbed environment is necessary to increase and accelerate the coordination between advances in force employment, and command and control concepts; doctrine and training; science and technology; and system acquisition and life-cycle support activities. Important new initiatives in DoD command and control planning, architecture, and testbeds are underway. These initiatives need to remain integrated and be extended to include a broader range of participants. In addition, much work remains to be done to strengthen these mechanisms and make them a part of the formal DoD organization and acquisition processes. This effort must explicitly improve the process for integrating system components based on new technology into evolving systems, and to evaluate the contribution to operational effectiveness attained by enhancing specific operational capability threads, as opposed to upgrading an entire system.

The partnership between the operational and technical communities started by the ABIS Task Force not only needs to continue but also must expand and be strengthened by including others in DoD necessary to implement this important part of Vision 2010.

7. Glossary

ABCC	Airborne Command and Control
ABCCC	Airborne Command and Control Communications
ABIS	Advanced Battlespace Information System
ACTD	Advanced Concept Technology Demonstration
AD	Air Defense
AOC	Air Operations Center
AOR	Area of Responsibility
App	Application (usually refers to automated applications)
ARPA	Advanced Research Projects Agency
ATACMS	Army Tactical Missile System
ATD	Advanced Technology Demonstration
ATM	Asynchronous Transfer Mode
ATO	Air Tasking Order
ATR	Automated Target Recognition
AWACS	Airborne Warning and Control System
B-ISDN	Broadband Integrated Services Digital Network
BADD	Battlefield Awareness and Data Dissemination
BDA	Battle Damage Assessment
BM	Battle Management
bpp	Bits Per Pixel
C2	Command and Control
C2I	Command, Control, and Intelligence
C2W	Command and Control Warfare
C4I	Command, Control, Communications, Computers, and Intelligence
C4ISR	Command, Control, Communication, Computers, Intelligence, Surveillance, and Reconnaissance
CDC	Combat Direction Center
CEC	Cooperative Engagement Concept
CEOI	Communications and Electronics Operating Instruction

CINC	Commander-in-Chief
CJTF	Commanders, Joint Task Force
CMA	Collection Management Authority
CMW	Compartmented Mode Workstation
COA	Course(s) of Action
COE	Common Operating Environment
CONOPS	Concept of Operations
CONUS	Continental United States
CORBA	Common Object Request Broker Architecture
COTS	Commercial Off the Shelf
CP	Command Post
CVW	Collaborative Virtual Workspace
DBC	Digital Battlefield Communications
DBMS	Database Management System
DCE	Distributed Computing Environment
DDR&E	Director, Defense Research and Engineering
DISA	Defense Information Systems Agency
DMS	Defense Message System
DSP	Defense Support Program
DTAP	Defense Technology Area Plan
DTO	Defense Technology Objective
ECCM	Electronic Counter-Countermeasures
ECM	Electronic Countermeasures
ELINT	Electronic Intelligence
EMI	Electromagnetic Interference
EO	Electro-Optical
ESM	Electronic Support Measures
FLIR	Forward Looking Infrared

FST	Fire Support Team
FTX	Field Training Exercise
GBS	Global Broadcast System
GOTS	Government Off the Shelf
HAE UAV	High-Altitude Endurance Unmanned Aerial Vehicle
HCI	Human-Computer Interface
HTACC	Hardened Tactical Air Command Center
IAW	In Accordance With
ID	Identity or Identification
IFF	Identification, Friend or Foe
IMINT	Imagery Intelligence
Infosec	Information Security
IP	Internet Protocol
IPB	Intelligence Preparation of the Battlefield
IR	Infrared
ISAR	Inverse Synthetic Aperture Radar
ISDN	Integrated Services Digital Network
ISR	Intelligence, Surveillance, Reconnaissance
IT	Information Technology
ITO	Integrated Tasking Order
IW	Information Warfare
JBC	Joint Battle Center
JCPMS	Joint Communications Planning and Management System
JFACC	Joint Force Air Component Commander
JFC	Joint Forces Commander
JFLCC	Joint Force Land Component Commander
JFMCC	Joint Force Maritime Component Commander
JIC	Joint Intelligence Center
JIT	Just in Time

JPEG	Joint Photographic Experts Group (Standard)
JROC	Joint Requirements Overnight Council
JSTARS	Joint Surveillance and Target Acquisition Radar System
JTF	Joint Task Force
JWCA	Joint Warfighting Capability Assessment
KCOIC	Korean Command Operations/Intelligence Center
LRC	Lesser Regional Conflict
M&S	Modeling and Simulation
MASINT	Measurements and Signatures Intelligence
MC&G	Mapping, Cartography, and Geodesy
MILSATCOM	Military Satellite Communications
MLRS	Multiple Launch Rocket System
MLS	Multilevel Security
MMW	Millimeter Wave
MOE	Measure of Effectiveness
MRC	Major Regional Conflict
MRL	Multiple Rocket Launcher
MTI	Moving Target Indicator
NRT	Near Real-Time
NTM	National Technical Means
O&M	Operations and Maintenance
OIW	Operations/Intelligence Workstation
OPLAN	Operation Plan
OPSEC	Operations Security
OTAR	Over-the-Air Rekeying
OTH	Over the Horizon
PGM	Precision Guided Weapon
POM	Program Objective Memorandum
RDT&E	Research, Development, Test, and Engineering

REECE	Reconnaissance
RMA	Revolution in Military Affairs
ROE	Rules of Engagement
RT	Real-Time
S&T	Science and Technology
SA	Situational Awareness
SAR	Synthetic Aperture Radar
SAS	Survivable, Adaptable System
SATCOM	Satellite Communications
SIGINT	Signals Intelligence
SOF	Special Operations Force
SONET	Synchronous Optical Network
SSCN	Secure, Survivable Communications Network
STS	Sensor-to-Shooter
TAC	Tactical Air Controller
TAP	Technology Area Plan
TBM	Theater Ballistic Missile
TCP	Transaction Communications Protocol (used with IP)
TCT	Time-Critical Target
TEL	Transportable Erectable Launcher
TFCC	Task Force Command and Control
TLAM	Tomahawk Land Attack Missile
TOC	Tactical Operations Center
TOT	Time Over (or On) Target
UAV	Unmanned Aerial Vehicle
VCJCS	Vice Chairman Joint Chiefs of Staff
VTC	Video Teleconference